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# ***JPRS Report***

# **Science & Technology**

***Europe***

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# Science & Technology Europe

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## AEROSPACE

### France: Arianespace Strategy Analyzed

#### Arianespace CEO Interviewed

91WS0466E Evry *ARIANESPACE NEWSLETTER*  
in English Jul-Aug 91 pp 1, 3

[Interview with Arianespace Chairman and CEO Charles Bigot: "Press Conference"; first paragraph is *ARIANESPACE NEWSLETTER* introduction]

[Text] Following the Annual General Meeting of shareholders of Arianespace at the 39th Paris Air Show, Chairman and CEO [chief executive officer] Charles Bigot reviewed the company's performance and future perspectives. Mr. Bigot then answered questions from journalists.

**Journalist:** Will the interruption of flights affect your financial results?

**Bigot:** A two-month interruption should not have any real impact on our financial results. Our fixed expenses amount to 40 to 50 million francs per month, but we think we can make up for the delay by accelerating our launch rate later. In any case, we had planned to amortize our fixed expenses over eight or nine launches this year and we will probably be able to carry out eight launches if we resume flights in mid-July.

**Journalist:** What productivity gains do you hope for?

**Bigot:** We began with substantial efforts to augment industrial productivity with the P9 production batch, and we have achieved a 20% gain. But we must do even better. We started to improve operational productivity. For the first time on Flight 42, we reduced the number of basic operations by some 30 to 40%. This required a considerable amount of work, which was naturally carried out with the help of our production partners. Operating costs represent about 20 to 25% of launch costs. Here, we hope to gain 10 to 20%. We are therefore trying to reduce our costs in all sectors because it is a vital necessity.

**Journalist:** Is there any progress in negotiations with the US to define "rules of the game" for launch services?

**Bigot:** American and European government officials are conducting these discussions. I went to Washington last fall to express our hope that Europeans and Americans would agree on several points.

The first is the marketing conditions for launch services: when the United States guarantees 80% of a company's sales, that is obviously giving this company a major advantage on the commercial market. It's not protectionism but we find it a rather excessive advantage. I had hoped to obtain access to the US government market, but so far the Americans have refused...

Secondly, we must define exactly what is taken into account in cost assessment. Our US competitors' fixed expenses are to a large extent paid by the US military forces. This allows them to offer very low prices on the commercial market—perhaps with virtually no operating costs. We hope to obtain similar cost assessment for all players.

Finally, we hope that Europe and the US will take a common position towards non-market economy countries. We must convince these countries to accept progressive access to the Western market and the respect of certain rules.

These are the three points that I stressed. Are we making progress? As regards our access to the US government market, the answer is no. On the other points, maybe... High-level conferences and a number of work groups have been scheduled. But discussions were only resumed a few months ago, and we must remain patient.

**Journalist:** What will happen if you cannot qualify the modification decided on for Flight 44?

**Bigot:** The modification undergoing qualification for Flight 44 was chosen among other possible solutions because it seemed the safest and the most interesting. If we find that we made the wrong choice, then we will immediately start qualifying another solution. But we are almost certain that we will be able to qualify this modification. I think the risk lies more in the fact that we might need more time to carry out qualification tests or to make adjustments.

**Journalist:** What is your agreement with the US company OSC?

**Bigot:** We signed an agreement with OSC in 1989 at the Paris Air Show because we believe that the Pegasus launch system is ingenious, not expensive and very flexible. It is only an agreement to work together and reach conclusions which I hope will be similar. We wanted to study the potential market in Europe and assess how well Pegasus is adapted to this market. We will take another few months to complete our studies. But I can tell you already that Pegasus as it is today will not satisfy the needs of the market as we perceive them, because this will take a more sophisticated launcher. We will therefore have to decide whether to continue with Pegasus, in which case we would probably develop a "Pegasus 2" or "EuroPegasus", at least if OSC agrees. I believe we will probably be able to take further steps at the end of this year."

**Journalist:** Do you include small satellites in your order book? And are you working on the development of a small launch vehicle?

**Bigot:** There are no small satellites included in our 93 firm contracts. Actually, we don't have any contract for mini satellites weighing several hundred kilos to be launched into low orbit—the kind of satellites Pegasus could launch.

As for micro satellites—10 to 50 kilos—, these are “friendly” contracts for which we don’t actually make marketing efforts. We benefit from our position as the world leading space transportation company and we feel a responsibility to assist organizations such as scientific laboratories. These services are very low-priced, since it is more a question of helping out the space community.

But we also feel that they may help the development of mini satellites. This is the market we’re aiming at in the long term with a new launch system, Pegasus or another small launcher. We have no development project. But, just as we are interested in Pegasus, we also keep close tabs on every project in this field, whether in Italy, Spain, Germany, France or elsewhere in Europe. Once we know precisely what the market is, we will know which launcher is best to suit it. And we will determine this by studying every project.

**Journalist:** The Chinese accuse you of taking the Arabsat contract away from them. What really happened? And do you think that the Chinese are now out of competition?

**Bigot:** We know Arabsat very well. We launched Arabsat 1A with success and we were sorry to hear that this customer had preferred to sign with the Chinese for Arabsat 1C. But they came back to us, asking if the offer we had made a year before was still valid. We said yes, without changing our price. Obviously, they were disappointed by the Chinese and chose a more reliable launch system, ARIANE. That’s all there is to it.

The Long March system has two drawbacks. First, the only launcher which has already flown five times, Long March 3, can only carry 1,400-1,500 kilos. And there are very few satellites with such limited mass. Also, Long March 2E can only place satellites into low orbit, which no longer meets customer requirements. The Chinese have obviously realized this and they’re now planning to add a cryogenic stage to their launcher. Furthermore, Long March 2E was only launched once with very dubious, unexplained results. I believe that transparency is the only way to gain customers’ confidence, and this has been our policy for many years.

Today in fact, Chinese launchers, for operational reasons—just like Soviet launchers because of the present situation in the USSR—seem to be less attractive to customers than ARIANE.

### Market Position Analyzed

91WS0466F Every ARIANESPACE NEWSLETTER  
in English Jul-Aug 91 p 5

[Article: “ARIANE Maturity Drives Positive Financial Results for 1990”]

[Text] Arianespace carried out seven launches in 1988, seven in 1989, six in 1990 and has a total of eight scheduled for 1991. This sustained launch rate reflects

the company’s mature expertise in the new business of commercial space transportation.

Arianespace generated sales of F3,979.2 million in 1990, a 5% rise over 1989, and posted net income of F135.4 million. The dividend payout of F16.2 million equals 6% of capital. Provisions for technical and commercial risks related to the company’s space transportation business totalled F1,152 million as of December 31, 1990.

Since its founding in March, 1980 Arianespace has always enjoyed a healthy financial position and has paid dividends to its shareholders for the past six years.

### Arianespace Participation: European Industrial Solidarity

Arianespace restructured its capital on February 1, 1990 by creating a holding company, Arianespace Participation, in order to better reflect industrial contributions to the ARIANE program.

Arianespace SA, which is 95% controlled by the holding company, has opened its capital to two new shareholders: Fiat Aviazione (Italy) and Societe Nationale des Poudres et Explosifs (SNPE, France). Italian firms have thus increased their stake in Arianespace from 3.6% to 7%.

These moves reflect Italy’s broader role in production of the ARIANE 4 launcher and in industrial ramp-up of the ARIANE 5 program. The new structure also provides greater flexibility for subsequent capital increases to support Arianespace’s growing commercial and industrial operations.

### A Leadership Position: Over 50% of the World Market

Arianespace logged excellent commercial performance in 1990, booking 15 orders worth an estimated F6.3 billion. The company’s deep backlog expresses the confidence of its global customer base amidst a fierce and often extremely aggressive competitive environment.

Four additional contracts have already been signed in 1991, giving Arianespace an aggregate total of 93 firm orders for satellite launches since the company’s birth. This business is worth nearly F33 billion.

The company’s order book currently stands at 35 satellites—17 of them non European—worth F15.4 billion. These contracts represent four years of work and already cover the first 20 ARIANE 4 launchers in the 50-launcher batch order signed with European manufacturers in 1989.

### 42 Satellites Launched in 43 Months

Over a period of nearly four years, Arianespace has sustained an impressive launch rate of one satellite per month. Unrivalled in the commercial launch service market, this performance was achieved despite a halt of several months following the Flight 36 failure.

To further improve productivity and ensure maximum levels of quality, Arianespace implemented a new operating plan, aimed at reducing costs and operating risks, as well as the interval between launches. The sustained rate of launches after Flight 36—seven in nine months—enabled Arianespace to make up for the delay.

#### Commercial Success Through a Focus on Quality

Following Flight 36, Arianespace asked its industrial contractors to significantly and immediately improve manufacturing procedures and controls. The company's cautious approach was behind the decision to delay Flight 44, thus providing the time needed to understand and correct an operating anomaly on the third-stage cryogenic engine.

Corrective actions currently being carried out by Arianespace in conjunction with CNES and engine manufacturer SEP (Societe Europeenne de Propulsion) should enable the launch campaign to resume at the end of June, with the launch by mid-July. Customers understand and accept this extremely rigorous approach, which is the source of ARIANE's reliability.

#### A Busy Second Semester

Taking into account the launch planned for July and the availability of satellites on the launch manifest, Arianespace plans to carry out five more launches by the end of the year, for a total of eight in 1991.

The first launcher in the batch of 50 ARIANE 4s ordered by Arianespace will be rolled out in the last quarter of 1991, and sent to Kourou for Flight 50 at the beginning of 1992. ARIANE 4 launchers will continue to keep pace with evolving market requirements, thanks to increased productivity due to this large scale production, and upgrades such as the enhanced-performance third-stage program initiated by Arianespace.

#### Expanding Services

Starting in 1996, Arianespace will be able to call on the ARIANE 5 heavy-lift launcher to satisfy new market needs at the turn of the century. ARIANE 5 is being developed by the European Space Agency, with CNES acting as prime contractor. Offering a payload capacity into geostationary transfer orbit of 6 metric tons (two 3-ton satellites in dual-launch configuration), ARIANE 5 will be in a perfect position to handle the heavier satellites expected to be launched by the end of the century. ARIANE 4 and ARIANE 5 operations will overlap for about three years, giving this new launch system the time needed to reach the required level of maturity under optimum conditions of safety and security.

Given the current international competitive environment, Arianespace believes that there should be a level playing field for all launch service operators, with identical regulations allowing access to still-protected government markets.

Arianespace has acquired extensive experience as a space transport provider. To maintain its leading edge, Arianespace is also closely studying and implementing new tools for access to space. Today, this strategy is represented by the ARIANE Structure for Auxiliary Payloads (ASAP), already deployed on ARIANE 4 to launch microsatellites under 50 kilos, and by marketing the Pegasus launch system in Europe for satellites from 100 to 500 kilos. For the future, Arianespace is keeping a close eye on the development of recoverable capsules and is studying the operational aspects involved in the launch of the Hermes space plans.

#### France's Sextant Avionique Develops Helmet-Mounted Sight

91WS0427A Paris LE NOUVEL ECONOMISTE  
in French 21 Jun 91 p 29

[Article by Kira Mitrofanoff: "Aircraft: The Smart Helmet"]

[Text] Will the helmet become a decisive air combat weapon? Hitherto designed to protect the pilot, it may soon be an essential flight and fire control tool. In France, Sextant Avionique, the flight electronics firm created in 1989 following the merger of Crouzet, EAS [Electronique Aerospatiale], Sfen and Thomson-CSF's avionics division, is currently working on several programs for Dassault's Rafale and the Franco-German Tiger helicopter. As for the British, the Ministry of Defense recently published the technical specifications for a new-generation helmet that may equip the future EFA (European Fighter Aircraft) fighter aircraft. Twenty-one companies responded, including the U.S.'s Kaiser and Honeywell, Britain's GEC Avionics, Israel's Elbit, and France's Thomson-CSF.

The idea is to design a new type of helmet allowing fighter pilots to sight their targets with a simple movement of the head. Thanks to built-in sensors, the pilot will be able to designate his target with his eyes before initiating fire. Currently, the sight is mounted on the aircraft, which means that the pilot must bring his craft into alignment with the target. This major time savings should guarantee victory in 75 percent of fights.

With the "smart" helmets, the pilot will also have a variety of information (including speed, fuel consumption, and altitude) right in front of his eyes, instead of on the control panel as in the past. Other research is focusing on low-altitude or bad weather nighttime navigation. Through a [helmet-mounted] module display superimposed on the external terrain, the pilot will be able to observe virtual images taken by an aircraft- or helicopter-external infrared movie camera whose line of sight tracks his head movements.

#### Lightweight, High Performance Helmet

This field of research interests most of the major electronics groups. To gain an edge, Sextant Avionique has joined forces with Intertechnique, a specialist in pilot

protection gear whose products include the Eros oxygen mask (35,000 copies sold worldwide). The goal of the two French firms is to build a high performance helmet that is also lightweight enough for the pilot to tolerate—in other words, less than 1.5 kg. If the duo succeeds, it will have a market of 800 to 1,000 helmets, including guaranteed orders to equip 300 Tiger antitank helicopters and 280 Rafale aircraft for the air force. And, in the bargain, it will be able to compete on international requests for proposals.

### Ariane 5 Development Highlights Presented

#### Industrial Process Integration

91WS0424A Paris INDUSTRIES ET TECHNIQUES  
in French 14 Jun 91 pp 70-71

[Article by Christian Guyard: "The Mureaux Rocket Plant: Ariane 5"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] Close to 600 million francs [Fr] invested to manufacture and integrate the cryotechnic main stage of Ariane 5. A facility consistent with the new industrial logic of launcher-cost reduction.

At Les Mureaux, Aerospatiale has the facilities it needs to produce heavy launchers on an industrial scale. Its objective is to maintain the announced rate of eight launches per year starting in 1996. Pascal Mauberger, manager of Cryospace, the company in charge of manufacturing the cryotechnic tank, summed up well the epic of Ariane. "Ariane 1 was because we had to fly at all costs; Ariane 2 and 3 were technological developments that validated a number of concepts; Ariane 4 marked the transition to series production. With Ariane 5, the word is to fly cheaper." Francois Calaque, manager of space transport at Aerospatiale went on: "This production setup is the normal consequence of the latest order for 50 Ariane 4. Here, the industrial logic is obvious: components, parts, sub-assemblies come in at one end of the buildings; at the other end, completed assemblies—the main cryotechnic stage—come out, ready to be shipped to Guiana. Simultaneously, the launcher's architecture was considerably simplified; it uses a single Vulcain cryotechnic engine and two powder boosters to carry the payload directly into low orbit." Additional precision: all these elements are manufactured the same way. For the two types of Ariane 5 missions, satellite launches and the launching of Hermes, the launcher reliability will be the same.

What is going on in Ariane City? Essentially, work is of two types. The first task, performed by Cryospace (an economic interest group formed by L'Air Liquide and Aerospatiale), is the construction and equipment of the cryotechnic tank. The second task, performed by Aerospatiale, is the production of the cryotechnic stage, i.e., the integration on the tank of the upper skirt connecting it to the storable-propellant stage and the payload, and the thrust frame that transmits the Vulcain engine thrust

to the cryotechnic tank; it also includes the installation of pyrotechnic devices (cutting cord, retro-rockets) and the entire electronic control chain of the launcher. These two operations are performed in two adjacent buildings right by the Seine, which eliminates the need for any exceptional road convoy and thereby reduces risks and costs. There is also a functional simulation facility designed to check all the subsystems involved in controlling the launcher in flight (in particular the nozzle orientation devices and the steering software).

Integration starts with the acceptance and storage of the front skirts and thrust frames.

#### An Obsession: Not To Exceed an Empty Weight of 5,630 kg

In the neighboring area, the preliminary integration of the thrust frame (two parallel docks) and the preparation of the skirt begin. In the third area, the integration proper is performed; it can handle three launchers simultaneously. This area has a ceiling height of 50 meters [m] (the Arch of Triumph would fit). This is where the skirt and the frame are riveted onto the tank. After that, the mechanical, electrical and pyrotechnic equipment is added; then all checks are performed. It takes 25 weeks. Three stages can be stored vertically. The next operation is to prepare them before they are again placed horizontally in a container that is then loaded on a ship in the nearby port.

But the stage that seems to be the most difficult is the construction of the tank proper. It is a huge shell designed to contain 131.6 metric tons of liquid oxygen at -180°C in its upper 6.7 m, and 25.6 metric tons of liquid hydrogen at -253°C in its lower 16.7 m; the two parts are separated by a thin wall (2 mm). The tank diameter is 5.4 m, and the wall thickness is 2 mm for the hydrogen part, and 4 mm for the oxygen part. "This is a structure which could collapse any time and must be kept under pressure like a child's balloon," P. Mauberger indicated. "It differs from the Ariane 4 third-stage tank in two main respects," he added. "First, through its size, which forced us to reexamine all handling and shipping problems. For instance, the straddling carriage used to carry the tank in the workshop is provided with accelerometers to make sure that the structure does not get distorted when it is moved. Another difference is the kind of alloy used: an aluminum alloy with 6 percent copper (the 2219 alloy, identical to the alloy used for the U.S. shuttle). Therefore, we had to develop a welding process. On the other hand, the thermal insulation is identical." And so is the main concern, not to say the obsession, not to exceed the specified empty weight of 5,630 kg! That is why thickness is mercilessly tracked down. The tanks are made of rings 3 m in height, which in turn are made by welding three curved sheetmetal parts. The latter were machined out of 13-30 mm gauge sheetmetal in order to leave the excess thickness required for welding and fastening. In spite of their thin walls, the tanks must support the engine fuel-supply pipes, the pressurizing pipes, antisloshing devices to limit any movements of



the liquid that might throw the launcher out of balance, and a lot of gages and instruments. After a surface treatment, the thermal insulation is glued to the metal, taking great care to avoid any excess that would increase the final weight.

One of the major scheduled dates, early in 1993, will be the testing of an actual tank for pressure strength until it explodes. The test will be performed in a 30-m deep well plugged with a 280 metric ton cover.

### Vulcain Engine

91WS0424B Paris INDUSTRIES ET TECHNIQUES  
in French 14 Jun 91 pp 72-73

[Article by Valerie Borde: "Cryotechnology Mastered: Vulcain Engine"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] The Vulcain cryotechnic engine will propel Ariane 5 in 1995; it will run for 600 seconds and burn over 150 metric tons of liquid hydrogen and oxygen. It will be reliable enough for manned flights.

Six hundred seconds to leave the Earth. The Vulcain cryotechnic engine will propel the Ariane 5 main stage during its first 10 minutes in flight. As in the HM7B third-stage engine of Ariane 4, propulsion will be provided by the combustion of a mix of liquid hydrogen and oxygen. Between the two launcher versions, however, the vacuum thrust was increased from seven to 107 metric tons! On top of the 1300 kg of the Vulcain engine, the tanks will contain 25 metric tons of liquid hydrogen at 20 K (-253°C) and 130 metric tons of liquid oxygen at 91 K (-182°C).

In the combustion chamber, the gases produced are accelerated in a nozzle followed by the divergent where they expand before being ejected at over 4,000 m per second [s]. The engine is cooled by liquid hydrogen flowing inside the wall. The combustion chamber is fueled by two turbopumps which raise the propellant pressure to 160 bar for hydrogen and 130 bar for oxygen. The European Space Agency has chosen SEP [European Propulsion Company] as the prime contractor for the propulsion of the Ariane 5 main stage. "We chose proven concepts and processes, so as to minimize development costs," Philippe Brossel, one of the program leaders, explained.

The Ariane 5 engine and the Ariane 4 third-stage engine differ in several essential respects. First, reliability. Considering that the program provides for manned-flight missions (with the Hermes spacecraft), the targeted reliability of the Vulcain engine is greater than 0.99—compared with 0.9 for the HM7 engine. This is a considerable improvement. Ariane 5 will be allowed only one failure out of 100 launches, instead of one out of 10 for the current launcher generation. Moreover, Vulcain will be fired on the ground, on the launch platform. The propellant combustion pressure will be as high as 100 bar (compared with 35 bar on the HM7B engine). Finally,

Vulcain will be fueled by two turbopumps instead of the single (dual) pump of its predecessor. Philippe Brossel explained the advantage of this solution: "We can alter the velocity ratio of the two turbines during the flight, so that both tanks get empty almost simultaneously." Thus the launcher will not carry any useless propellant.

### Vulcain Engine Forged Out of Nickel-Chrome Alloys

The revolution lies in the materials. The Ariane third-stage engine uses mostly stainless steels and aluminum alloys. Vulcain uses mostly high-strength nickel-chrome alloys (Inconel 718, Waspaloy). "Already in 1987, all materials were typed in their thermal environment. Manufacturing processes were adapted to suit the nature of each part," Philippe Brossel recalled. For instance, in the hydrogen turbopump, the return duct, which is subject to considerable stress, was to be made of one piece. The engineers chose the lost-wax casting process (the male part of the pattern dissolves during casting), which was known but had never been used with an aluminum alloy.

To manufacture the engine, various parts are first machined; machining must be perfect where liquid hydrogen is involved. This is why the SEP chemical laboratory, like all centers working on the Vulcain engine, participates in process development, and controls and inspects all parts. Most of the work involves studying surface conditions and the embrittlement of materials exposed to liquid hydrogen. The laboratory is equipped with tensile-test machines operating at a temperature of 20 K.

When all components are ready, the engine is put together in the assembly hall, where it is also prepared and taken apart before and after each test. For operations as tricky as these, a clean room is a must. The 1,200 m<sup>2</sup> of class-100,000 area are divided into 12 cells, but in the neighborhood of the 25 laminar-flow hoods the class may be reduced to 100 particles per cubic foot. Amidst all this "cleanliness," the engine is king. Not even the smallest part is ever handled by hand. The mobile overhead crane moves parts on longer distances; the handling trolleys are fully adapted to the supports that will receive the various parts.

The components come from European manufacturing plants: MBB [Messerschmitt-Boelkow-Blohm] in Germany for the combustion chamber; Avica in Great-Britain for the turbopump exhausts; Volvo in Sweden for the divergent and turbine; Fiat in Italy for the oxygen turbopump; and SEP for the hydrogen turbopump. Plus Italian electrovalves, a Dutch starter motor, English exhausts, Irish brackets, etc. Of course, all parts are monitored by a computer, including those that will never fly.

The main occupation of assembly hall engineers is with the gages and instruments. For each test, Vulcain is outfitted with about 500 sensors. Measuring temperature gradients in the divergent requires the installation of some 100 probes. It takes 150 hours to outfit a single

turbopump! In fact, wiring the engine requires four engineers working for five weeks.

The deadline is getting close. Two identical test benches were built for the European Space Agency: SEP's PF-50 in Vernon, and MBB's P-5 in Lampoldshausen, Germany. They were designed for 15-minute firings. The propellant tanks are huge: 600 m<sup>3</sup> of liquid hydrogen, and 200 m<sup>3</sup> of liquid oxygen.

The first flight, scheduled for 1995, should cost \$90 million and carry 23 metric tons into low orbit, compared with \$100 million and seven metric tons for Ariane 4. Until 1995, 18 engines will be manufactured.

#### 500 Bench and Launch-Stand Firings

"The tests serve only to verify projections," Philippe Brossel insisted. Nothing is left to chance. Before each firing, everything is modeled. The risks have been minimized by the structure development program; wasting taxpayers money is out of the question. First, the components (pumps, turbines, bearings, etc.) are modeled. Then, the subsystems, e.g. the gas generator and the turbopumps, are tested 240 times, at various development stages. Finally, the complete engines will be tested 500 times, first on the test benches, then on the Kourou launch stand.

First stage: Checking mechanical strength. The first thing to test is the resistance to vibrations and to the heat produced by the two powder boosters that frame Vulcain. The compatibility of resonance frequencies is checked on a vibration model. After that, tests are made to check the engine firing sequence. This means studying transient conditions; the objective is to demonstrate the valve-opening synchronization margins. To date, 27 tests have been completed on three engines; the design operating point was reached and held for less than 10 s. A holding time of 600 s will be achieved by the end of 1991. The engines must also be typed, i.e., the deviation between two versions must be assessed. The tests will represent 20 billion measuring points, stored in the Etna-5 operating system. All European sites are equipped with terminals; engineers may select data for mathematical or graphic processing at all times. Two hundred tests, representing 1 billion measuring points, are immediately accessible.

Starting at the end of 1992, tests will be performed to demonstrate Ariane's reliability, as it may have to carry men with Hermes. Tens of failure occurrences are already anticipated, from a rotor imbalance to a delayed sequence, and including a hydrogen leak; all will be modeled and then tested. The date is 1995, in Kourou.

#### Turbopumps

91WS0424C Paris INDUSTRIES ET TECHNIQUES  
in French 14 Jun 91 pp 74-75

[Article by Alain Perez: "A Jewel of Hydraulics: Turbopump"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] The Vulcain engine is fueled through two turbopumps. These are certainly the most complex and most powerful hydraulic components ever developed in Europe.

A maximum power output of 21,000 hp for a weight of 240 kg. Five times the power/weight ratio of an aircraft engine. The hydrogen turbopump of the Vulcain engine is certainly the most complex hydraulic component ever developed in Europe. It is also the component that will be subjected to the most severe mechanical stresses one can imagine. On one side, liquid hydrogen at -253°C; on the other side, hot gases (over 600°C). The qualification of this major component of the main Ariane 5 engine should take place at the end of 1994. At the European Propulsion Company (SEP), Philippe Brossel, who has managed the program since 1987, is surprisingly confident. "We have exceeded 600 seconds of cumulative testing. We are making the seventh unit in a series of 25 turbopumps to be used for development tests. All is according to projections. We have a small excess weight of about 10 percent; but that was to be expected and we are not overly concerned about it."

Basically, the hydrogen turbopump is just a powerful compressor. A compressor with a rated power output as high as 12,000 kW. That is, approximately that of a high-speed train. It was designed to feed liquid hydrogen (LH2) to the Vulcain engine at the rate of 41 kg of propellant per second. It runs at 34,200 rpm and raises the fuel pressure to about 150 bar. A similar pump (developed by Fiat) will do the same for the liquid oxygen (LOx). With these two turbopumps, Vulcain will thus burn a total of over 240 kg of cryogenic propellants per second. Combustion and expansion in a divergent will provide thrust to the launcher. The two turbopumps are located on each side of the engine. They, in turn, are powered by combustion gases from a generator.

Some 20 European companies are working together on the project. Volvo is making the turbines, Hispano Suiza the bearing support. Many laboratories, including ONERA [National Office for Aerospace Studies and Research], Metraflu, Bertin, Sulzer and Battelle also contributed to the preliminary development and typing work. "We are about one-third through the program and we have completed about 50 of the 160 tests planned," Philippe Brossel indicated.

This is not the first cryogenic turbopump made by SEP; it has been making engines since the start of the European launcher program. The third-stage engine of the current generation (HM7) includes a single turbopump (actually two pumps coupled by a gear train), which gave quite a headache to the program leaders. This time, the European Space Agency cannot afford to take a risk. The reliability demanded of the launcher is 0.99 (one failure out of 100 launches). The Europeans, therefore, financed a complete development which started with an intense computer modeling campaign and a series of partial tests. "From the start, we had identified 40 points or so that were deemed critical. They involved mainly vane

vibrations, bearing sliding, hydrogen-cooling of bearings, the resistance of materials to sealing [sic]. But, mostly, we were worried by the dynamic aspects of the rotor. The modeling and experimenting work was started very early. Actually, it works better than expected," Philippe Brossel indicated.

The SEP official's confidence also confirms the success of simulation and data processing. "We have made considerable progress in this respect. It's an entirely different world, compared with Ariane 4. The strain modes and critical velocities are as indicated by the models. To such an extent that we no longer perform any test without first computing a projection. Two years ago, very few engineers would have bet on the efficiency of this approach. When I joined the program, there was not much faith in computed projections." But computing is not everything, and bench testing will now relay the computers. Some 100 development tests will be followed by 120 aging tests. The last stage will include the 20 final demonstration and certification tests. A giant test bench (PF52) was built at Vernon to test the turbopump assembly. It was used for the first time in April 1988. It was designed to simulate tests lasting about 100 seconds. The PF52 bench is a project on its own: high-pressure (180-bar) propellant supply system, 12-m<sup>3</sup> liquid hydrogen tank under a 400-bar pressure.

#### 20 Testing Facilities for Individual Components

And, of course, a complete monitoring system: 512 measurement channels, a 50-ms response time to an occurrence, a computing capacity of 5.4 million instructions per second. The data will be stored on a 490 megabytes disk. Simultaneously, over 20 testing facilities for individual components have been set up at the Vernon site.

The era of craftsmen is over; the Vulcain engine and the hydrogen turbopump are assembled with the benefit of a state-of-the-art production workshop and a clean room (class 100,000). SEP drew its inspiration from the aeronautical techniques used by its parent company, SNECMA [National Aircraft Engine Research and Manufacturing Company], for its production processes and organization. "While we were working on the design, we also completed the qualification of the machining, welding and surface-treatment processes," Philippe Brossel indicated. With its three machining centers and its vertical lathe, the production workshop is very much like any other mechanics workshop, except for two details: the materials used and the machining times.

The pump impellers are the most complex parts. They are made of TA6V titanium and machined two by two on the same machine. It takes a total of 270 machining hours to drill intricate channels through the metal. Special controlled-bending tools were developed specially for the job. The machines are working at night and the manufacturing schedule is booked until mid-1993. "We are also a production company," Mr. Francois, head of the manufacturing workshop, pointed out with

pride. "We must also preserve our credibility as a manufacturer with our European partners. This takes expertise and production tools."

Assembly is of course the most difficult part of the operation. In this case, too, the change of scale by comparison with Ariane 4 is striking. White coats are de rigueur in the assembly hall used for all Vulcain components. Three work stations are assigned to the hydrogen turbopump; the seventh unit of the first series is about to complete its cycle. The final assembly will require six to seven months of work, i.e. more than the engine proper.

Efficiency is here and so are production and testing means; that leaves reliability and cost. On the technical side, the tests currently in progress will be the last judge before qualification. "The only technical unknown is the service life. The specifications require the ability to withstand about 20 cycles of 600 seconds each," Philippe Brossel indicated. As for the cost, it is a crucial factor in the Ariane 5 program which ambitions to cost 20 percent less than Ariane 4. The hydrogen turbopump is one of the most expensive components in the world, after the divergent and the combustion chamber. About 20 million francs, i.e. about 20 percent of the cost of the complete Vulcain engine. "We are not there yet, but we shall manage. We shall have to struggle hard," the engineer added. This amounts to a cultural revolution in a sector where, until now, economic considerations were of secondary importance.

#### Boosters

91WS0424D Paris INDUSTRIES ET TECHNIQUES  
in French 14 Jun 91 pp 77, 79

[Article by Valerie Borde: "Ariane 5 Ready to Fire; Boosters"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] Two hundred and thirty metric tons of powder, 27 m high, 1,200 metric tons of thrust... European size and power-output records for the two Ariane 5 boosters.

What is 27 m high, weighs 260 metric tons and lasts only 123 seconds? A clue? The "thing" develops a thrust of 630 metric tons in vacuum, is always accompanied by its twin brother, and should show up on TV screens in 1995. The answer will be no surprise to space fans: it is a powder-propellant booster of the Ariane 5 launcher. For the novice, the boosters are these two large cylinders that frame the rocket body and burn off after two minutes in flight.

Ariane 4 already uses powder-propellant boosters with a maximum thrust of 62.5 metric tons for certain missions. However, the transition to Ariane 5 amounts to far more than a mere change of scale; together, the 3-m diameter boosters will deliver 1,200 metric tons of thrust! Vulcain, the cryotechnic main engine, will provide only 100 metric tons of thrust (during the first 10 minutes of flight). It will be fired first, on the ground. Only after it has reached its maximum thrust will the

firing of the boosters be triggered. That will start a two-minute suspense during which two metric tons of gas per second will be ejected at the speed of sound through the divergent of each nozzle.

In each booster, thrust is generated by burning 230 metric tons of solid propellant with a texture like that of an ink eraser. The powder is composed, by weight, of 68 percent of ammonium perchlorate (PA) produced by Eupera (a subsidiary of SNPE [National Powders and Explosives Company]), 18 percent of aluminum, and about 14 percent of polybutadiene (PBHT) for a binder. Approximately, because the recipe works only when certain fillers are added, mostly combustion and reticulation catalysts. The aluminum is oxidized by the PA and produces gases, at a temperature of about 3,300°C and a pressure of 60 bar. The propellant must be used up, without any shock, because ammonium perchlorate can decompose in two other not very advisable ways besides combustion (at 10 mm/s): It can deflagrate (100 m/s) and it can detonate (8,000 m/s)!

The SNPE research center specializes in the study of solid-propellant combustion. After a thermodynamic study of the mix, researchers make a model of the flame-front development and gas flow. "In this field, everything remains to be done," physicist Bernard Gondouin explained; "we must model the behavior of hot gases under pressure, which include particles (the alumina produced by the reaction), for velocities both above and below Mach 1." The propellant is a material with very characteristic mechanical properties (it is viscoelastic and nonlinear) which require some heavy computing. The SNPE's armada of Vax computers is not enough. The Cray of the Polytechnic School and a Convex vector computer are also used.

The propellant is mixed in a 1,800-gallon mixer supplied by the U.S. company Day, the only non-European company in the program. It is then cast and polymerized in the booster body, around a mold (the core) which gives it the internal geometry required for a good combustion. It took nine months, not including the design stage, to make the core, a steel part weighing 14 metric tons and 11 m long. The PTFE treatment was the key operation; it consists in coating the core body (made of steel) with an antiadhesive (Teflon). The coating must then be sanded, then painted and cured at 400°C.

The outside of the booster is a steel envelope manufactured by the German company Man and consisting of seven cylindrical rings. BPD takes care of the 4.3 metric tons of rubber heat shields.

#### **The Nozzle Throat: A Single 180-kg Carbon-Carbon Part**

The booster consists of three parts: the forward section manufactured by BPD in Italy, and the middle and rear sections (comprising three cylindrical rings each), which are loaded with powder in Guiana. These operations, and the final assembly in Kourou, are performed by Regulus, a subsidiary of SNPE and BPD.

The connections between sections are of vital importance in booster technology. They were incriminated in the Challenger accident. On Ariane 5, the same concept was applied, but the details of the geometry and the materials are not the same. "We chose to implement the concept of 'yoke pins', which eliminates the need for welds that could lengthen manufacturing time and are hard to check," Philippe Gil, the project head of technical control at Europropulsion, the economic interest group formed by SEP and BPD to manage the program, explained. The connections between sections are the most difficult to make, because they are in direct contact with the combustion gases. The connections between the cylindrical rings are masked by the heat shields.

Propulsion is achieved through the expansion of gases in the nozzle. The nozzle, weighing 6.2 metric tons, may be oriented at an angle of up to 6° to correct the thrust orientation. It is therefore connected to the booster body by a flexible stop. Two jacks, mounted near the base of the divergent, are used for steering; they must be capable of straightening the nozzle while withstanding the 40-metric-ton propulsive force. It is hard to imagine what it is like inside the nozzle; by comparison, an aircraft turbo-jet engine looks like a hair-dryer! Under these conditions, the selection of materials is of more than paramount importance. The structure is made of steel, covered with a heat shield made of silica and phenolic carbon for the divergent and the body. The flexible stop consists of a stack of rubber and metal layers; it must remain rigid under compression, but not under shearing. The nozzle throat is the narrowest part—90 cm in diameter—and the most heavily stressed. It is protected by 180 kg of a carbon-carbon composite, the only material with adequate strength. This is the largest one-piece part ever made out of carbon-carbon material.

The nozzle is made in Bordeaux, at the UTB (booster nozzle plant). Set up in 1990, this unit represents an investment of Fr160 million (Fr45 million from SEP and Fr115 million from ESA [European Space Agency]). It will manufacture three nozzles per year until 1995, and then 16 per year to guarantee the launching rate (the first nozzle was finished in May 1991). Each nozzle body is wound on turning machines. The composites (carbon and phenolic silica) are polymerized in an autoclave (at 160°C). After the 12 composite parts have been wound, a four-axis machine drills over 20,000 degassing holes. The blank is then X-rayed (using an 11-MeV accelerator) in a well that is 8.5 m deep and closed by two 30-metric-ton lead doors. All surfaces are then degreased and washed. The flexible stop is drape-formed, after which the assembly is glued and undergoes ultrasonic testing. Before it is mounted on the nozzle, the stop goes to a test bench where its tensile strength, compression strength and shear strength are tested. All that is then left to do is to check and test the nozzle assembly before shipping it to Kourou.

Tests will continue until 1995. Between the mock-up firings and the first launch, 10 tests are scheduled to take place in Kourou. The first one will take place during the first quarter of 1992.

**Germany: DARA Director Anticipates Reduced Aerospace R&D Funding**

91MI0461 Bonn DIE WELT in German 27 Jul 91 p 19

[Article by Anatol Johansen: "The Missing Millions Will Affect the ESA"]

[Text] The national German aerospace industry is being threatened by substantial cutbacks. This was stated by DARA [German Aerospace] Director General Wolfgang Wild to DIE WELT. Because of the relatively high contributions made by the Federal Republic of Germany to the ESA [European Space Agency], which will amount to about 1.25 billion German marks [DM] in 1992, some DM100 million will be missing from the national program.

A projected increase of DM70 million has been cancelled and not reinstated. An additional DM30 million have been deducted from the national program to make it possible to afford the higher ESA contribution.

In total, funding for the national German aerospace program will amount to DM580 million in 1992. Of this, DM157 million is being allocated to the DLR [German Aerospace Research Institute], DM60 million to DARA and to IABG [Industry and Plant Operations Company]. Thus, some DM360 million remain for national aerospace projects, some DM100 million less than previously planned.

According to Wild, it would be extremely difficult to carry out the cutbacks that have now become necessary. A series of projects could be affected, including, for example, the unmanned German-American space flight mission for the continued exploration of comets. A German-Soviet program for the exploration of Mars in 1994 could also conceivably be affected. In the latter case it has been proposed that a special German camera will be carried by the Russian Mars probe.

According to Wild, cancelling this joint project would be particularly painful because a recording device developed in the new laender (Zeiss-Jena) would be involved.

Moreover, an ambitious national satellite project appears to be threatened by the current financial situation. This is the special environmental research satellite, ATMOS which the Federal Republic wishes to develop within the national framework. Wild predicts that the measuring equipment developed for the satellite could possibly be carried on a European satellite instead, such as the ESA polar platform.

The projects that will now actually fall victim of the cuts should be made known shortly. According to Wild, the

relevant recommendations will be published around the middle of August. Manned space travel is not involved.

**German Scientists Debate Manned Space Mission Funding**

91WS0440A Stuttgart BILD DER WISSENSCHAFT in German Jun 91 pp 92-93

[Interview with Professor Erhard Keppler, Technical Director, Max-Planck-Institute for Aeronomics in Katlenburg-Lindau, and Dr. Ulf Merbold, Physicist and Scientific Astronaut of the European Space Organization [ESA], by Juergen Nakott: "Are Manned Space Missions Worth the Billions?"; first two paragraphs are BILD DER WISSENSCHAFT introduction]

[Text] Germany has been asked to contribute 8 billion German marks [DM] to the cost of developing the rocket Ariane 4, space lab Columbus and space glider Hermes. However, there is controversy about the usefulness of manned space missions.

Prof. Erhard Keppler, 60, signed the memorandum of the German Society for Physics which recommends discontinuing manned space flights. Dr. Ulf Merbold, 49, participated in the Spacelab I mission in 1983 and is currently preparing for his second space flight planned for February 1992.

**BILD DER WISSENSCHAFT:** Dr. Merbold, the German Society for Physics (DPG) has come out against future government funding for manned space missions. They said they could see neither scientific nor economic benefits in the foreseeable future that would justify the large expenditures.

**Merbold:** I consider the resolution one-sided, to put it mildly. In some points, it is incorrect and also arrogant, in particular when physicists think they can judge the value of medical research. They never even mention the biological studies. Moreover, their statement proceeds from the basically incorrect assumption that the gathering of scientific data by unmanned space missions is less expensive.

**BILD DER WISSENSCHAFT:** Dr. Keppler, is the DPG in fact arrogant?

**Keppler:** Some time ago, the DLR issued a glossy brochure which gave the impression that we would bring back from space complete turbine buckets next week at five o'clock or that we would soon be growing gallium arsenide crystals for the production of high-performance chips in space. That was at the time when the Bundestag debatee participation in the Columbus and Hermes projects. This presentation was highly questionable.

Their reasoning was based on speculation about what could be possible one day. By now, this euphoria has subsided considerably, and everybody is talking about basic research only. No serious person talks about any kind of production in space any more.

**BILD DER WISSENSCHAFT:** Is it correct to say that you do not question the basic scientific usefulness of manned space flight, contrary to the DPG memorandum which you signed?

**Kepler:** I do not want to doubt the basic scientific value of the Columbus and Hermes projects, but it must be perfectly clear that the materials research under weightless conditions as well as biological and medical experiments constitute basic research, and do not yield any economic or technical benefits within the foreseeable future.

Admittedly, if it is certain that a meaningful experiment can be conducted on a manned space flight only, then a manned mission makes sense. But at the moment I cannot think of anything that could not be accomplished by unmanned missions as well. I have been involved in the aerospace field for thirty years, and I am firmly convinced that the first attempt at solving a scientific problem must be the development of an effective robot.

**Merbold:** First I would like to correct a basic misunderstanding, possibly an intentional misunderstanding, that is your statement that robots are less expensive. We know the exact price tag of one mission, that is the D1-mission on Spacelab. This mission cost a total of DM400 million. This includes the cost of the shuttle flight, all other NASA services, the development of experimental facilities, the establishment of the ground control center in Oberpfaffenhofen and the cost of astronaut training. I would like to compare this figure with the cost of the scientific satellites which the ESA and also the Germans have sent into space over the past few years.

According to latest figures, the scientific satellite Ulysses which is designed to fly over the sun poles, carries a price tag of more than DM330 million. The Halley probe Giotto cost a total of DM400 million. ERS, the European Remote Sensing Satellite, intended for environmental research among other things will cost more than DM1.5 billion. The X-ray telescope ROSAT carries a price of DM560 million.

Only a few experiments have been installed on each of these satellites. If you compare that with the approximately eighty experiments for the D1 mission....

**Kepler:** But you can't compare these at all...

**Merbold:** Admittedly, it is somewhat arbitrary. At any rate, you will come to the conclusion that manned space flights are considerably cheaper than unmanned flights, almost 90 percent cheaper.

**Kepler:** You will not get a picture of a comet when you are flying at an altitude of 300 km. The tasks are completely different, and you cannot assign a definite sum of money to each experiment. If you want to scan the sky using x-ray light, you need a giant telescope such as ROSAT. For astronomy, this will undoubtedly mean a quantum leap forward. On the other hand, we should not

forget completely the technological aspect. The experience Zeiss gained from the development and extremely precise manufacture of the telescope mirror brought the company a technological advantage in the international market.

But for many experiments, going into space is not necessary, even if you need zero gravity as a test condition. We have parabolic flights, we have the gravity tower in Bremen, we have the Texus high-altitude research rockets in which you obtain six to eight minutes of weightlessness, sufficient for many experiments.

**Merbold:** Where this method accomplishes its goal, it should be used, no argument about that. But there are processes, the growth of plants, for instance, or slow-growing crystals, where you need days, sometimes even months, and there a rocket is of no use at all.

**Kepler:** If that is not enough, you just launch an unmanned satellite into space with a programmed robot on board.

**BILD DER WISSENSCHAFT:** Can robots really do just as much as humans?

**Kepler:** Considering our current objectives: an unequivocal yes.

**Merbold:** In my experience—and I got my hands dirty in manned space flights over the past 12, 13 years—in many cases it makes more sense to use robots, even for manned missions. They are great if you only need to start an experiment and the computer can carry it out. But there are many experiments where a human being offers a much greater guarantee that the desired objective can be reached cost-effectively.

If little is known about a process or a physical condition, then it is more difficult to program a computer or design a robot to handle this problem. What puts man ahead of the machine is his great ability to learn from his mistakes. The machine does only what it was programmed to do.

There are, for instance, monocrystals which grow beautifully, and this process can be automated. But there are materials where growing crystals is more an art than a science. There you need someone who has observed the growth of these crystals over many years. Such a person can tell early on that one crystal will grow, and they other won't, and he can therefore guide the experiment. A machine is not able to do that.

**Kepler:** But scientific experiments are not one-time deals. Experiments must be repeated, their design must be changed before you get useable results. And just when you are ready, a Shuttle may be defective again, or other missions are more important, and the researcher may have to wait five to six years until he gets a second chance. This is one of the absurdities of this way of thinking.

If the whole thing had been designed differently from the very start, from small-scale to large-scale, from parabolic flights to unmanned satellites, and if we had realized then that we can't get ahead this way, the manned option might be acceptable. But here we have Spacelab for which Germany paid DM1 billion and it flew two missions....

**Merbold:** ...it flew four missions, twice with European participation...

**Keppler:** ... and twice with the Americans, ok. On the other hand, we now have a new political situation which makes the whole thing look much simpler. The Russians are quite willing offering to take people along on MIR flights. There would be a whole range of opportunities, and we could use what others are offering before deciding to invest billions with uncertain prospects of success.

The perspectives are somewhat nebulous. There is almost nothing real, tangible that could not be accomplished by other means as well. And so far, none of the scientific results has really impressed me either.

**Merbold:** It would be nice if the physicists in the Federal Republic of Germany were not prejudiced from the very outset against the results gained during manned missions and would not say: This might possibly require our money, therefore let's stall it for now. Sometimes you get this impression.

Biological experiments studying the sense of balance in man, for instance, were able to refute a theory concerning the function of the vestibular organ in the inner ear for which the Austrian Robert Barany was awarded the Nobel Prize before World War One.

I admit that this is strictly basic research. But the information the Giotto probe obtains about the Halley comet is also basic science. It does not mean that because of this information somebody can buy an improved product in a store tomorrow. You cannot use two different yardsticks.

**BILD DER WISSENSCHAFT:** The German Society for Physics was accused of attacking manned space flights only to obtain a better position in the fight over limited research funds.

**Keppler:** According to present estimates, development of Ariane 5, the space station Columbus and the space glider Hermes will require DM35 billion...

**Merbold:** ... DM22 billion according to ESA...

**Keppler:** ... and Germany has been asked to contribute DM8 billion plus operating costs later on. According to ESA and DLR estimates, annual costs will amount to approximately DM1 billion, but my personal opinion is that the taxpayers will have to come up with DM2 billion per year.

If I deduct from the so-called federal research funds the money allocated for technical developments, Germany spends only a total of DM16 billion for basic research, and this includes the funds for the German Research Association and the Max-Planck-Institutes. If I take from this sum DM2 billion per year—maybe only DM1 billion—then I am changing the German research scene. This is the concern that motivated the DPG.

**Merbold:** The BMFT is a ministry for technology as well, not only for sciences.

**BILD DER WISSENSCHAFTEN:** Is it fair to say that the DPG is bashing manned space flights in order to get more for its own research projects?

**Keppler:** The Nobel prizes over the past few years did not come from space flights, but from research areas where German industry and research is ahead. We really have every reason to speak of a blossoming research landscape.

**Merbold:** I do not want to discredit German support for the sciences. But in all fairness, I have to point out that the work done for the Nobel Prizes which German scientists received were usually not done in German laboratories. You can ask physicist Gerd Binnig, molecular biologist Georg Koehler or Georg Bednorz and Klaus von Klitzing. They conducted their crucial experiments outside the Federal Republic.

Therefore we cannot say that because of our research policy over the past few years Nobel Prizes have dropped into our laps like ripe apples from a tree. And in addition to its scientific importance, space flights are also important for technology and industry, and we should not forget the philosophical dimensions of manned space flights either. Even the DPG recognized this aspect in its statement, when it said that the advance of man into space has a strong appeal. This is an aspect that should not be ignored completely.

#### Italy, China Sign Space Collaboration Accord

91MI0430 Rome SPAZIO INFORMAZIONI in Italian  
3-10 Jul 91 pp 4-5

[Text] The Italian space delegation led by Senator Learco Saporito, under secretary for universities, with representatives from the ASI [Italian Space Agency] CIRA [Italian Aerospace Research Center], Alenia Spazio, Laben, Telespazio, Fiat Spazio, Fiar, Officine Galileo, and Ciset [Italian Technical Services Company], concluded a visit to China a few days ago. The delegation met with Chinese Minister for the Aerospace Industry Lin Zongtang in Beijing, where they signed a bilateral agreement on collaboration in space exploration and study for nonmilitary purposes. The agreement covers three areas primarily: scientific programs; microgravity tests, with the possible use of Chinese reentry capsules; and scientific and applications satellites, in particular for telecommunications and remote sensing. Furthermore,



the document envisages defining other bilateral initiatives in the area of launchers and launch sites. Under secretary Saporito stated: "We consider the Chinese Long March launchers to be very interesting. Their use could strengthen Italy's position in the commercial launch services market. In view of our future independence and given the uncertainties and delays of the Italian-American San Marco Scout project, we could use Chinese launchers and launch sites." In Beijing, it was decided to establish working groups composed of scientific and industrial representatives from both countries who will identify projects of mutual interest in areas such as launchers and launch services, microgravity, remote sensing, and scientific programs. A Chinese technical delegation has been invited to come to Italy in October for a series of meetings and visits.

### Italian Aerospace Association Examines Future Needs

91MI0428 Rome SPAZIO INFORMAZIONI in Italian  
19-26 Jun 91 pp 2-3

[Text] "Italy runs the risk of losing its industrial standing with serious consequences for the entire country. Becoming dependent of foreign countries for supplies in the high technology aerospace sector will dissipate the valuable technological assets and human resources that have been acquired with great effort." This worrisome statement is included in a press release by the AIA [Aerospace Industries Association] at a recent meeting held in Rome to present its 1990 annual report. On that occasion, the press was also informed that Roberto D'Alessandro will replace Fabrizio Foresio as AIA president.

### AIA Proposals

The AIA press release reads as follows: "The industrial and production factors policy, established by the Italian government and Parliament within the framework of European integration, has set, among others, the following primary objectives: speeding up the process of internationalization; further developing advanced technology sectors; and concentrating human and financial resources in strategic sectors. The aerospace sector fully meets those general objectives. Indeed, back in May of 1981, its role and characteristics were fully and formally acknowledged with CIPI's [Interministerial Committee for the Coordination of Industrial Policy] resolution to approve the targeted plan for the aerospace industry.

"As the aerospace sector has been pointing out constantly with growing concern for years, it has been excluded from the large-scale initiatives that have benefitted other industrial sectors in recent years. This lack of coherent parliament and government planning has led our sector to the current critical situation that has already had adverse effects on employment levels. Unless parliament and the government change course soon, in 1992 the Italian aerospace industry will rank very low in the European Community, where practical

industrial policy initiatives are being taken to enhance competitiveness in strategic sectors including aerospace, electronics, and telecommunications. A single reference and coordination point at government level for such a complex sector would certainly facilitate the establishment of a permanent link with government bodies."

### 1990 Figures

According to information released in Rome, Italian aerospace industries registered an overall turnover of 7.5 trillion lire in 1990, with a 4.4 percent real term increase over 1989. Exports, which accounted for 36.4 percent of the turnover, were close to the 1988 minimum after a slight recovery in 1989. The 1.3 trillion lire trade balance, instead, remained unchanged, while investments rose substantially to 1.29 trillion lire. Jobs in the sector amounted to 50,700; 35.5 percent of which are in southern Italy.

### The Space Sector

In answer to a question by SPAZIO INFORMAZIONI, Alenia President Fausto Cereti said: "Space activities currently account for a significant share of the Italian aerospace companies overall budget." Cereti also pointed out that almost 1 trillion of the sector's annual turnover of around 7.5 trillion lire comes from projects carried out on behalf of the ESA [European Space Agency] and the ASI [Italian Space Agency]. When asked to comment on the contents of the 1990-94 National Space Plan, Cereti stressed that, "The ASI project submitted to the CIPE [Interministerial Committee for Economic Planning] corresponds to the needs and capabilities of our industry within the budgetary restrictions to be set by the government. This is why we will fully support the plan."

### Italy Hosts Space Station Conference

91MI0429 Rome SPAZIO INFORMAZIONI in Italian  
3-10 Jul 91 pp 2-4

[Text] At Columbus VII, the seventh edition of the now traditional symposium on the use of space stations held in Capri recently, customary technical problems had to give way to political and financial discussions. The over 300 participants examined the many technological and applications aspects of the entire Freedom international space station program (and in particular European participation with Columbus pressurized modules). Attention, however, was also paid to the decision that will be taken at the ESA's (European Space Agency) next ministerial meeting to be held in Munich on 18 and 19 November. ESA Director General Jean-Marie Luton said in Capri that, "All countries are getting ready to confirm the decisions made at the meetings held in Rome and The Hague. Financial problems, however, do exist, and we must find a satisfactory solution for all." Several countries felt that the budget for the ESA's long term plan (about 33 billion European currency units [ECU]) to the year 2000 was exaggerated. Germany, for example, requested a 15 percent reduction, while the



ESA's proposed cutback would not exceed seven percent. Given the extent of the problem, the decisions to be taken in Munich are awaited with great anxiety at all levels: governments, space agencies, scientific communities, industries, and users.

#### Speeches by Guerriero, Napolitano, Vallerani

A press conference was held with ASI (Italian Space Agency) President Luciano Guerriero, director of the Aerodynamics Department at Naples University Luigi G. Napolitano, and Alenia Spazio President Ernesto Vallerani.

Referring to the upcoming ministerial meeting and the current financial problems, Prof. Guerriero stated that, "The ESA countries are not shirking their responsibilities, even though they all share Germany's budgetary problems. Europe intends to use cooperation with the United States as a means to achieve autonomy and ultimately competitiveness. Therefore, a review of the existing program is out of the question, even though the proposal to be submitted to the ministerial conference will have to be amended and geared to real possibilities."

In turn, Prof. Napolitano referred to rumors of a dramatic downsizing of the space station project when he said that, "The European scientific community is not greatly concerned and is in fact rather confident. Microgravity," he added, "has opened up new prospects for other scientific areas. Hence the importance of preparing for Columbus with the precursor flights. For this reason we have proposed to the ASI the development of a small MarSat satellite." Indeed, the MARS [Microgravity Advanced Research and Support] center, directed by Prof. Napolitano, recently submitted an offer for the feasibility study of this micro-satellite (less than 100 kg with a 30 kg payload) to the ASI scientific committee. The satellite could be launched into a geostationary transfer orbit as a "secondary payload" in the European Ariane 4 mission. MarSat will be equipped with a standard module for on-board services (communications, telemetering, electricity produced from solar cells, etc.) and a scientific payload for microgravity tests to be controlled from Earth with remote-control systems. The first micro-satellite might be launched in 1994.

Prof. Vallerani, instead, stressed that, "We all have short term and financial problems, but we should not lose momentum in our space effort. We are all prepared to accept budgetary cutbacks provided investment in space activities remains a part of European policy." The Alenia Spazio president then disclosed that, by November, "legal procedures will be completed for the establishment of what is probably going to be called EuroColumbus," an Italian-German joint venture between Alenia Spazio and Deutsche Aerospace that will work as prime contractor for the ESA for the supply of the two pressurized Columbus modules.

EuroColumbus, with Germany holding 60 percent of the shares and Italy 40 percent, could include a future

participation of France's Matra, the company responsible for the polar platform.

#### Under Secretary Saporito's Statement

"Without the proper political preparation, the November ministerial meeting could be a major failure and throw the ESA into a crisis." The statement was made by Senator Learco Saporito, under secretary for universities and research, during a meeting with the press in Capri. Senator Saporito also stressed that, "If the ESA has not solved all its problems by November, the meeting might be postponed until next spring. We are in no hurry, unlike France which is pressing for an immediate decision in favor of the Hermes space shuttle." The problems listed by Senator Saporito are numerous:

- 1. The development of the DRS [Data Relay Satellite] has yet to begin;
- 2. Italian participation in the ESA has not yet yielded reasonable economic and technological spin-offs;
- 3. There are still very few Italians in leading positions and no decision has yet been taken on new appointments for the management of the ESTEC [European Space Research and Technology Center] in Noordwijk (Netherlands) and the scientific program;
- 4. No attempt has yet been made to turn the Kourou launch site in the French Guyana into a European center;
- 5. The ESA's legal status needs to be reviewed.

Senator Saporito then announced that the government had appointed Prof. Napolitano as the new president of CIRA [Italian Aerospace Research Center] to replace General Lamberto Bertolucci. The senator also said that CIRA's 1991 working capital currently amounts to 9.5 billion lire, to be increased to 14.5 billion in 1992, 24.5 in 1993, and 40 billion per year starting in 1994.

## AUTOMOTIVE INDUSTRY

### Survey of Electric Cars With Lead-Free Batteries

91WS0428A Paris LE NOUVEL ECONOMISTE  
in French 21 Jun 91 pp 26-27

[Article by Pascal Galinier: "Batteries: The End of the Lead Era"; first paragraph is LE NOUVEL ECONOMISTE introduction]

[Text] Behind the big industrial maneuvers lies a major technological prize: the electric car.

The "Europe of batteries" is taking shape against a backdrop of North-South confrontation. In the south the Franco-Italian pair of CEAC/Magneti-Marelli—a product of the Alcatel-Alsthom (ex-CGE) union and Fiat, with sales of 5 billion French francs [Fr]—is the new European market leader, with a claimed share of 26 percent. In the north is Varta-Bosch, an alliance of German giants in automobile and electrical equipment. With Fr4 billion [in sales], it has nearly a quarter of the same market.

One sign of the importance of the shakeup is the fact that the European Commission has investigated the two alliances. Commissioner Sir Leon Brittan thinks he spots a threat to competition—and, gibe certain backbiters, to Japanese-British industry—in the deals. To gain control of 51 percent of CEAc, Magneti-Marelli will have to relinquish within the next three years 65 of the 75-percent capital stake it acquired in the CFEC, the other big French battery maker, in 1990. The new entity would have swallowed up too large a share, over 50 percent, of the French market. Varta and Bosch are also under European scrutiny, for alleged crushing of the German and the Spanish market, where Bosch is the second-largest producer through its subsidiary Femsa. This intransigence on the part of the Community's executive branch could benefit the industry's long shot, the Spanish firm Tudor, which ranks third in Europe with 14 percent of the market. Tudor Espana, which is a subsidiary of the Banesto and Banco de Santander banks and has sales of Fr2.5 billion, is moving its chess pieces beyond its borders. It bought Hagen in Germany and has concluded a joint-venture agreement with the chemicals manufacturer Neste. Among the Spanish firm's loyal customers are French manufacturers, who took a rather dim view of the two big French battery makers' takeover by Fiat. This gives Tudor a weighty argument for applying to buy out the CFEC. Unless Brussels's reticences play into the hands of the Japanese. The two Japanese industry leaders, Yuasa and Japan Storage Battery, have already clinched joint ventures in Europe, with Britain's Lucas and Italy's Fiamm respectively.

#### On The Eve of New Upheavals

What is at stake in this round is a protean market of Fr18 billion. Half of it consists of automobile batteries, the so-called starter batteries. The other half is divided roughly equally between traction batteries, for lift-trucks for instance, and industrial or stationary storage batteries. The concentrations that are being created aim to reduce the balkanization of the European industry. "There are three big manufacturers in the United States, five in Japan, and still 40 of us in Europe," observes Mr. Claude Darmon, CEO [chief executive officer] of Saft. That is too many for a product squeezed between fluctuating raw material prices and automakers "who have not conceded us a price increase for ages," bemoans Mr. Jacques Leclercq, CEAc's president and general director. And too many for a product that is on the verge of new upheavals, and consequently of new technological investments.

"The life of a lead battery has doubled in 10 years, and its weight has been cut in half, for the same power. We are not likely to repeat such a performance over the next 10 years," admits Mr. Jean-Louis Claudel, in charge of planning and new activities at CEAc. Behind the industrial reshuffles, then, are the outlines of emerging new technologies and players, impatiently awaiting their chance for a role in the future market now in vogue: electric cars. The latter are one of the auto industry's old sea monsters that resurfaces at long intervals. Has their

time finally come? "Fifteen years ago the motivation was to save energy; it faded when cheap oil made a comeback. Today, the awareness is linked to the environment, in the sense of ecology and traffic gridlock," notes Mr. Jean Barnerias, in charge of strategy in Renault's purchasing department. Cities such as Los Angeles, Munich, or Athens are already toying with the idea of banning classic cars from their downtown areas. The two major drawbacks of all-electric cars—limited autonomy (60 kilometers) and low peak speed (80 kilometers an hour), become secondary in urban areas. "All the studies show that 70 percent of the car trips in cities come to 50 kilometers or less a day," points out Mr. Jacques Hilaire, from Renault's research division. Small firms such as Jeanneau, a maker of recreational boats but also small cars and vans, have struck out into the urban market. "But the emergence of such a market still depends on a major automaker deciding to launch a mass-produced electric vehicle," admits Mr. Darmon. This will happen in 1994, when electric versions of the small Peugeot 105 and perhaps the Renault Clio will be marketed. PSA (Peugeot Co.) sees potential sales of at least 400,000 electric cars in Europe by 1995.

That leaves the problem of adapting storage battery technology. Accumulators no longer bear much resemblance to the traditional batteries you find under the hood of today's automobiles. A starter battery requires a very high level of power over a short time span—the time it takes to start the thermal engine. It is then recharged by the alternator. A traction accumulator is the very source of a car's energy; it runs down completely but gradually. In traction storage batteries, two technologies have locked horns from the start: the lead/lead-oxide pair, immersed in an electrolytic bath of sulfuric acid, and the nickel-cadmium pair in an alkaline solution. Lead still rules the road, because of its excellent price-performance ratio. At equal power, a nickel-cadmium battery is lighter and longer-lasting, but three times as expensive. A utility vehicle carrying a total load of 3.8 metric tons and desiring autonomy of 95 kilometers in an urban environment will have to carry 1.2 metric tons of lead batteries, but only 800 kilos of nickel-cadmium ones. But with a guarantee of a long production run, such as the one Peugeot is expected to give it, Saft is confident that it can halve the cost of its batteries. Saft is the latest Alcatel Alsthom subsidiary and the world leader in nickel-cadmium storage batteries. When it took over the Swedish company Nife in March it clearly demonstrated its ambition to play a major role in electric cars. Nife, which does a great deal of work on the nickel-cadmium pair, is partners with the American carmaker Chrysler. "A market of 30,000 electric cars means Fr1 billion for us," greedily comments Mr. Darmon. Even if the construction of a factory means an investment of Fr600 million, it is well worth it.

#### The Blessing of French Manufacturers

Confronted with these new kids on the block, the "leads", as the industry's traditional manufacturers are dubbed, are working double time to make up their lag in

electric cars. With its acquisition in 1989 of the English firm Chloride's (CMP, Chloride Motive Power) traction division, its recent takeover of Germany's Sonnenschein, and the support of Magneti-Marelli, CEAC has garnered the ultimate in lead traction-battery technology. Besides its 8 percent German market share, the German family company is bringing to CEAC its research on gelled electrolyte, which makes it possible to manufacture tight traction batteries. Moreover, the acquisition of Sonnenschein received the discreet blessing of French manufacturers who, although hailing the technological progress of Saft, are lukewarm about its world-dominant position in nickel-cadmium. "Although the big carmakers are turning up their noses, the big electronics manufacturers are showing great interest in our projects," affirms Mr. Dominique Mathon, director of Jeanneau's Microcar Division. Mr. Mathon deplores his lack of access to the state-subsidized clean-car program of PSA and Renault.

For the next five years then, the battle will be waged between lead and nickel-cadmium. Experts agree that after 1995 what they call "exotic pairs"—nickel-iron, nickel-hydrogen, and especially sodium-sulfur—will enter the field. And a new wave of manufacturers such as the Swiss-Swedish firm ABB will emerge, or former big ones such as Chloride will come back, until solid lithium batteries appear around the year 2000. Unless, in the meantime, the thermal engine and the "inherently slow progress of electrochemistry" deplored by Mr. Barnerias have relegated the electric car to the museum of aborted good ideas.

#### France: Limitations of Robots Described

91WS0473A Paris L'USINE NOUVELLE in French  
20 Jun 91 pp 28-30

[Article by Alain-Gabriel Verdevoye and Odile Esposito: "Automobiles: Robots Peak Out"; first paragraph is L'USINE NOUVELLE introduction]

[Text] French automakers are all making the same observation: Robotized production lines are expensive and, because of their sophistication, unreliable.

The "cathedral-building" era of the automobile industry is over, laid to rest with the myth of ultra-automated factories. The near-religious belief that robotization was the miracle cure for all the ills of the French automobile industry is being replaced by a much more empirical approach, based on an analysis of past errors. Massive investments in heavy and hyper-complex production systems—as costly as they are unmanageable and as difficult to develop as they are unreliable—are finished.

The technological panoply of the model eighties factory is no longer bringing them in. "The last 10 years were the decade of costly flexible workshops. The nineties will be the decade of skepticism about oversophistication," stresses Jacques Malavas, CEO [chief executive officer] of Renault Automation.

Indeed, "from now on, the first source of productivity is the reliability of production tools," explains as if in echo Jean-Yves Helmer, director of PSA's (Peugeot Corporation) automobile division. So priority has shifted to simplicity and efficiency at least cost. One example is Citroen's lines, where workers have gone back to manually mounting the door cutouts on the ZX, a model that was marketed last March. The task was automated for the XM, brought out in 1989.

The same thinking prevails at Renault. "The company did not follow up on the experiment involving laser cutting of sun roofs that was begun in Sandouville. The line speed was too slow, and it was difficult to maintain a perfectly functioning system over three eight-hour shifts," staff at Renault Automation explain.

As for the Clio sheet-metal shop in the Flins factory, it is now 99-percent automated. But that percentage will fall back to around 80 for future installations. For "the production cost is too high," asserts Manuel Roldan, director of production technologies at Renault. And heavy-truck makers, followed by equipment manufacturers, have adopted a course that is just as pragmatic.

#### Jettisoned Plans

At RVI (Renault Industrial Vehicles) for instance, no more flexible shopfloors, such as the one that machines the gearbox cases in Boutheon, near Saint-Etienne, will be made. The reason: Just a few years after being put into operation, the data-processing setup must be totally reconditioned and the wire-guided cars rebuilt. For its part, Valeo has jettisoned plans to automate the packing of headlights at line's end. "Too complicated and not profitable," explains Robert Pinon, the manufacturing director at Valeo Lighting.

French automakers consider the case closed: The construction of "gas factories," such as the ultra-sophisticated Fiat installation in Cassino, must be avoided. The latter technological marvel is in fact so delicate to operate that three years after beginning assembly of the Tipo, barely 1,400 cars a day are coming off the lines, instead of the 2,000 planned.

A duly noted reality lies behind these revisions of automation-robotization strategy: The rate of machine use is much higher in Japanese factories than it is in Europe. And if the equipment works better and breaks down less in Japan, it is because it is much simpler.

This observation, moreover, is valid for all the steps in automation. The Japanese automobile industry has, in fact, outfitted itself with many vision systems. "But it is very simple equipment—single-task and located close to the sensor. We are a very long way from the applications developed in the Old World, in which 40 or 50 cameras communicate with each another," says Pierre Boulet, the boss of Dicom, a contract research company specializing in industrial vision systems. PSA has 30 vision systems and Renault has about ten. But how many of them are really operational?

The essential strong card of the Japanese is that the relative simplicity of their industrial tooling saves them long and costly hours of research and development. This goes a long way toward explaining why the investment cost per vehicle of the Japanese auto industry is half that of Europe's. The task, it is true, is facilitated by the constant concern of the Japanese for quality. The very narrow size spread in body parts, for instance, facilitates automated assembly using simple tools! In contrast, the greater the spread, as in France, the greater the need for smart and costly systems able to compensate for such faults.

"Costs are our nightmare," is the wail heard at Boulogne-Billancourt, headquarters of Renault. The point is made less loudly at PSA, but it is given just as much thought. The Grande-Armee Avenue group plans, over the next three years, to equip itself with automated systems that will cost 20 percent less than those installed three years ago. The move is meant to reduce the expenses of launching a new model, and thus to speed up the marketing of new lines.

#### Less than Obvious Quality Gains

Certainly there is no question of contesting the whole strategy to automate and robotize production. Quality improves when robots and automatons are used to machine mechanical parts, paint, or perform most sheet-metal assembly operations. But, when it comes to assembly, "the gains are not obvious," stresses Jean-Yves Helmer.

As proof, consider the fact that the Villaverde Peugeot factory in Spain is the least automated of the "mark of the lion's" sites. And yet it boasts the best production-quality record for the 205. The rate of automated assembly operations should not exceed 10 percent overall at PSA, and 20 percent at Renault: rates that are still a far cry from those in practice at the Cassino Fiat plant in Italy.

"We robotize only the arduous tasks," says Manuel Roldan. Robot makers will barely let this drop, but they have all observed the same thing: The automobile industry is currently slowing down its purchases. "The slackening in investment is particularly noticeable among French carmakers," comments Guy Micoulet, president of ABB-Robotics France.

On this score, the figures are eloquent: in 1990, PSA bought only 220 robots (compared to 440 the preceding year). The drop is even more spectacular at Renault: 29 robots (compared to 140 in 1989). "And 1991 will be very quiet," predict Renault Automation staff.

#### A Despondent Market

This economic trend is causing serious problems for robot manufacturers, notably in Renault's specialized subsidiary. True, the slowdown in purchases is part of a cyclical phenomenon peculiar to the automobile industry. Yet manufacturers' new approach, featuring

substantially more modest robotization plans, counts for a great deal in keeping alive the gloominess of the equipment makers.

The Renault Automations, ABBs, and other Comaus are going to have to adapt. How? By simplifying equipment and cutting their prices. ABB Robotics, for example, has undertaken an ambitious program to cut costs by 25 percent in 24 months. According to PSA, the average cost of a robot has fallen from 800,000 to 500,000 French francs [Fr] in two years. A reduction in the number of components and technical simplification have been big factors in these price changes.

Fortunately, robot makers have other customers besides Renault and PSA. Fiat, especially, does not seem to share the approach of PSA or Renault. For some specific reasons. "The two new factories that Fiat will build in southern Italy, at Melfi and Avellino, will be just as automated as the one in Cassino," says Giuseppe Zingoni, in charge of marketing and sales in Comau's robot division. "The lack of qualified personnel in the region makes it imperative."

And, add those with more slanderous tendencies, because investments are so heavily subsidized in the south of the peninsula that the Italian automaker can well afford to spend that much money on particularly costly automated systems.

As for French carmakers, from now on they want to take their cue from the simplicity of the Japanese. Paradoxically, however, "Japanese groups are turning toward increasingly automated production plants. The lack of manpower and the rise in the cost of a work hour forces them to," comments Roberto Rossi, an expert with the consulting firm of Booz-Allen & Hamilton.

#### Delegations of Japanese

Honda and Toyota delegations visited Peugeot's installations in Sochaux and Citroen's in Rennes to see how the PSA group's automated stations operate. And to use them as a model, notably in the factories they are building outside their own country. Mitsubishi was forced to automate to the hilt its Diamond Star installations, a joint-venture with Chrysler. Its goal was to compensate for the poor quality of the American manpower. Mitsubishi was not, moreover, spared the [usual] start-up problems.

These changes in the Japanese approach do not look as if they will call into question the new choices of the French groups, which are doling out their investments sparingly. In their desire to follow the example of Japanese manufacturers come hell or high water, are not PSA and Renault running the risk of adopting an outmoded conception?

## COMPUTERS

### Massive German Computer Network Taps Into International Research

91WS0402 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 7 Jun 91 p 8

[Article by Erika Pomsel: "Three Supercomputer Centers To Ensure Connection to International Research: What Is To Be Germany's Largest Massively-Parallel Computer System Opened in Aachen]

[Text] A massively-parallel computer system was officially installed recently in Aachen. The super-cluster currently consists of 256 processors; however, it is to be upgraded twice, for a total of 512 processors. This, according to Professor Klaus Habetha, vice chancellor of the North Rhine-Westphalian Technical University, will make it the largest massively-parallel system in the Federal Republic of Germany.

The initial cost of the first configuration level was 4 million German marks [DM], DM750,000 of which was contributed by North Rhine-Westphalia. The German Research Association (DFG) intends to use this investment to ensure that Germany is tied into international research. Three such super-systems, including the Aachen Super-Cluster 256, have been installed in German technical university computer centers within a few weeks of one another. The two other systems are a 256-processor parallel system at the Hamburg-Harburg Technical University, and the Paderborn system, which, with 320 processors, is currently the largest freely configurable parallel computer in Europe.

The Aachen super-cluster is intended to be used primarily for the DFG flagship program "Current Simulation using High Performance Computers," which was begun in 1989. Professor Egon Krause, director of the North Rhine-Westphalian Technical University Aerodynamic Institute, is the program coordinator. The program participants voted unanimously to have the new transputer system installed in the RWTH (School of Technologies for Manufacturing Processes at the Technical University of Aachen) computer center.

Consequently, teams from the Universities of Erlangen, Heidelberg, and Stuttgart also have access to the computer, as do scientists from ten colleges and two sites (Cologne and Goettingen) of the German Aerospace Research Institute (DLR). The researchers are linked to the center via the German Research Network (DFN) Scientific Network (WIN), either directly or via data lines. The front-end server is a Sun 4/330 Workstation, which provides multi-user operation via eight separate access lines to the Transputer-Cluster. More access lines are to be added later.

Some of the teams in the sister project "Parallel Algorithm" are equipped with on-site development stations.

These are either transputer in-boards for Sun workstations, IBM PS/2's and MacIntosh II's (four to eight nodes), or Multi-Cluster I/II transputer minisystems (eight to 16 nodes).

Since 1989, the Aachen computer center's general-purpose computer for research and teaching has been a high performance IBM 3090-60 S/VF with six processors and six vector facilities. The center is also responsible for the operation of the SNI S-600/10 (as of 1992, S-600/20) high performance computer, which serves as vector processor for North Rhine-Westphalia and is accessible via WIN to all the universities in that land. Such high performance and memory capacities are necessary in order to numerically simulate complex flow patterns. Two basic systems are used for high performance computing at the RWTH Aerodynamic Institute: vector computers with extremely high single-processing capabilities, and parallel systems linking many processors of more limited individual capabilities. Accordingly, the solution algorithms must be tailored to the computer's architecture.

Of particular interest in fluid mechanics are solutions to the Navier-Stokes Equations, as these equations provide the most comprehensive description of flow of a continuum. These solutions are essential to a basic understanding of flow patterns, such as turbulence. But they are equally important to industry, particularly the auto and aerospace industries.

A major part of the research that occurs in Aachen is the development and application of procedures for arriving at numerical solutions. Current applications of these methods include research into the three-dimensional hypersonic flow around a spacecraft, research into flow in a piston engine, and research into unsteady eddy flows. DFG-supported plans call for the use of vector computers to significantly improve the solution algorithms that have been optimized over the past ten years. Proven solution procedures are to be modified for use on parallel computer systems, and new, parallel, algorithms are to be developed.

In one of the first steps of this plan, two developed solution procedures for the Navier-Stokes Equations have been formulated for parallel computation by breaking them down by area. Both algorithms include two procedures: a central solution procedure based on unsteady, periodic vortex shedding around a cylinder, and a procedure for calculating transsonic, turbulent flow around the profile of a hydroplane. Test calculations of both procedures indicated a high degree of parallelization. The researchers now plan to use an interactive solution to demonstrate both procedures on the new massively-parallel system, then graphically display the results.

The Stuttgart University computer center, a participant in the main DFG project, has assumed responsibility for allotting assets for the visualization of calculations made on super-high performance computers. Because the

human being's ability to grasp such tremendously complex calculations is severely limited, better use must be made of available data acquisition capabilities. Procedures for allotting visualization assets are of particular importance for computer centers that provide supercomputing services to remote users.

The objective is to involve the user as closely as possible in the simulation and enable him to directly intervene in it. The scientist should have the impression that his workstation computer has the same capabilities as the remote supercomputer.

The Aachen Super-Cluster 256 is intended to be used primarily for research in fluid mechanics. However, according to Falk Kuebler of Parsytec Computer GmbH in Aachen, who was selected as project director from among four candidates, another challenge for parallel processing is also emerging. He says that the teraflop computer may significantly change the status of very high performance computers in Europe.

According to Kuebler, quantum chromodynamics (QCD), which concerns the internal structure of a nucleon, requires computation capabilities approximately 1000 times that of today's computers. He says that intensive conceptual work has resulted in a concrete, reliable, and feasible plan for producing a teraflop computer of this capacity. Furthermore, the computer could be produced without assistance from non-European countries.

Nor are teraflop computers valuable only for physics research. Other major applications include on-screen pharmaceutical drug design and meteorological and climatological research, the latter of which is becoming increasingly important to humanity. Other possible applications range from machine technology to electrical engineering to economics.

## DEFENSE R&D

### Matra's Plans for Missile, Helios Development Announced

*91WS0418B Paris AFP SCIENCES in French  
20 Jun 91 p 19*

[Text] Le Bourget—Mr. Jean-Luc Lagardere, president of the French group Matra (satellites, missiles, electronics), reaffirmed the company's plans to expand its strategy of European and international alliances in the fields of earth observation and missiles at the Bourget Show on 17 June.

The group, which devotes 1.5 billion French francs [Fr] to research and development in its defense-space division (40 percent of the group's total sales), aspires to be the leader in civilian and military earth observation satellites. In particular, it intends to adapt its Mica air-to-air missile to European planes.

According to Mr. Noel Forgeard, director of the group's Defense Space holding company, the missiles will be made "interoperable," that is, usable on several types of planes and with several kinds of radar. A study conducted with Germany on the Mica missile (intended for the Mirage 2000-5 and the Rafale) shows that it can be perfectly adapted to the German F4 Phantoms as well as the Scandinavian F16s, Mr. Forgeard stressed.

Given the plans to renovate European army planes, the missiles market will be equal to the market for new planes. And the replacement of American Sidewinders will be staggered over a 15 to 20 year period, he stressed.

Matra and Marconi plan to respond before 6 August to the first bid invitation to equip British airplanes with Mica-derived missiles issued by Great Britain to competitors of the British Aerospace-Hughes Aircraft alliance.

The French authorities have asked Matra to study an improved Apache missile equipped with a terrain-monitoring system that, thanks to new technologies, is purported to outperform the American Tomahawk used during the Gulf War.

With respect to military earth observation, Mr. Forgeard indicated that the two flight models of the French military satellite Helios would be launched in 1994 and 1995 respectively. "We are working with the military to prepare the second generation—Helios-3 and Helios-4—which will be fitted with infrared sensors, direct ground linkups, and radar, in addition to the optical systems now used."

## ENERGY, ENVIRONMENT

### EC Prepares Directive on Ozone Pollution

*91WS0466D Brussels EUROPE in English  
3 Jul 91 p 11*

[Article: "EC/Environment: The European Commission Has Submitted a Directive to the Council Over Air Pollution by Ozone"]

[Text] Brussels, 02/07/1991 (AGENCE EUROPE) - The European Commission has just submitted to the Council a draft Directive on the pollution of the air by ozone (O3), more precisely the tropospheric ozone, that is the ozone found in the layer just below the atmosphere. The Directive which the Commission would like to see come into force on 1 January 1993, has three objectives:

- 1. Set up a framework to control the concentrations of ozone by setting up or completing measuring networks. In the EC, measuring ozone concentration is recent and far from being applied throughout the Member States;
- 2. Set up a system of information exchange between member States, the Commission and the future European Agency for the Environment (EAE) allowing for greater knowledge of the problem;

- 3. Guarantee information to the public in case of situations where the ozone level could present risks to health, through a system of alarm. The thresholds set down in the Directive are reference levels corresponding to the requirements for health and vegetation protection conforming to WHO [World Health Organization] recommendations.

The Commission's approach is a two step approach: the proposal provides for a second stage, after five years of the alarm procedure being in operation, in which it will be possible to set binding limits to be respected throughout the Community. Currently, our knowledge does not allow us to set objective and binding limits for ozone concentration in the air. This is why the first stage aims to set up several Community actions which will enable those concerned to widen their knowledge of the problem and limit the consequences of high concentration of ozone for human health.

The proposal comes in the context of different EC actions in the fight against atmospheric pollution by oxidizing photochemicals of which ozone is a main component. This type of air pollution is considered to be one of the major problems for the environment in the years 2000. Concentration of photo-oxidising agents in general and ozone in particular, notably due to exhaust emissions, is worrying as it has a negative effect on human health (irritation of the eyes, headaches, breathing difficulties), nature (slow-down or perturbation in vegetable growth) and materials (degradation of buildings etc.)

#### French Environment Minister Interviewed

91AN0498 Paris SCIENCES & AVENIR (Special issue No 83) in French Jul-Aug 91 pp 4-5

[Interview with French Environment Minister Brice Lalonde, by Marie-Jeanne Husset: "Science's Hopes"; first paragraph is SCIENCES & AVENIR introduction]

[Text] For the environment minister, some of the major missions of research are: Estimating the number of living species, understanding the function of the carbon cycle, and studying soil contamination levels and the impact of new technologies.

**SCIENCES & AVENIR:** Protection of the environment is currently one of the major concerns of the French. This concern is recent. How is your ministry coping with this new demand of society?

**Lalonde:** When I became Minister of the Environment, I very quickly realized that the structures that were set up 20 years ago were obviously not up to today's problems and that there was the risk of a growing gap between the ever more urgent expectations of society and the too limited responses that we were able to provide. I therefore asked the government for a substantial increase in my ministry's budget, especially for work in the field,

e.g., for the establishment of genuine regional services and the creation of an environment and energy control agency.

Having said this, there would not be a viable Environment Ministry if there had not first been companies, associations, elected politicians, officials from all departments, journalists, or consumers who voice their opinions, become active, and take responsibilities in their fields. My ministry acts as a mediator among these parties, encouraging their initiatives, stimulating discussions, and interpreting the public's more or less vague concerns and demands to the other ministries and the government. The politically important thing is that the department in charge of the environment must better correspond to what each of us expects of it. It must provide solutions to concrete problems of everyday life.

This is not always the case because it often happens that we are not involved in crucial decisionmaking processes, such as selection of major infrastructure programs, high-speed trains, highways, electric power lines, dams, etc. In this respect, I proposed and obtained major changes, since the environment will now be represented in the agencies that really count in the decisions, such as the Interministerial Commission for the Development of the Territory or the Economic and Social Development Fund (FDES), which plays a major role in the targeting of public investments.

We must thus become better organized to meet the demands, but also to foresee them whenever necessary and be able to anticipate future problems and alert public opinion, even at the risk of preaching in the desert for a long time and being accused of being prophets of doom. This watchdog role is also another fundamental function of any environment minister: The ecology has paid too long for being almost always "one battle behind."

**SCIENCES & AVENIR:** Protecting nature, fighting pollution, improving the quality of life, protecting the planet: How can you fight on all fronts, from local to global issues, and reconcile sometimes contradictory demands?

**Lalonde:** The only way to fight on all these fronts is by better distribution of responsibilities and establishment of a schedule with priorities and goals with a well-defined time frame. This was done in the national environment plan which I submitted to Parliament for discussion in October 1990 and which last December was accepted by the government as a general guideline for the next 10 years. As far as I am concerned, from this plan, which is in line with European policy, I singled out three priorities for 1991: water, waste, and protection of coastlines. This is not incompatible with the efforts that we have undertaken since 1988 to give France some power of initiative in international negotiations, in particular on global problems: In Madrid we just signed the convention on the Antarctic and we are actively preparing for the 1992 world environment conference in



Rio de Janeiro, which will bring together the countries of the Northern and Southern hemispheres. Of course, it is not very easy to prioritize constantly these regional, national, or international levels: My position, which corresponds to a certain permanent feature of French policy, is that we must try to instill as much scientific objectivity and social justice as possible into these decisions.

**SCIENCES & AVENIR:** What role do you assign to research in this policy?

**Lalonde:** An essential role. Indeed, environment policy shares with health policy the fact that it cannot be elaborated without continuous input of scientific data and know-how. In this field, research is not only one useful instrument among several others; it really plays an essential role. We are indebted to scientists for having alerted us to the major problems that threaten our planet as well as our everyday life. We are turning—and will have to turn more and more—to them for preparing standards or implementing technical innovations without which there can be no durable improvement of the environment. This is a major task and responsibility which affects all research sectors: fundamental science, applied research, or technological innovation.

In this area, like in many others, we have fallen somewhat behind in the past; environmental research suffered badly from the consequences of the budget restrictions imposed as a result of the economic crisis, which caused a 40-percent reduction in the budget of my ministry between 1986 and 1988. Industrial companies have only recently become aware of the economic stakes involved in the development of clean technologies or products. Until the early eighties, scientists working on environmental issues in the major laboratories had difficulties—that is a euphemism—in having the scientific significance of their research work recognized and obtaining adequate funding.

True, the trend has definitely been reversed these last few years, but one cannot reasonably be satisfied with a situation in which 60 percent of world research is conducted by two countries: the United States and the former Federal Republic of Germany. The national environment plan thus recommends a quadruplication of government and private expenditures for environmental research within 10 years. We must also improve coordination, acquire a better understanding of the research potential in each organization, establish cooperative structures in major industrial sites, and provide concrete solutions to the problems of hiring young researchers and of training procedures.

**SCIENCES & AVENIR:** Should the Environment Ministry be directly involved in this research?

**Lalonde:** I noticed that all the environment ministries which conduct an active policy—the United States, Sweden, the Netherlands, the former FRG, etc.—have their own major research institutes, budgets, or departments. This is no accident. In order to conduct an

appropriate environmental policy, efficient research is needed and, for research to be efficient, it must be solidly linked to society's demands and to political action. My ministry now obtains about 3 to 5 percent of the government's research budget for environmental research in France. Considering what I have already said about the significance of this research, it would be alarming to fall short. I have explained the general reason on the basis of foreign examples. I will add one which is more specific to France: If we wish to use our research potential more efficiently in the future, we must absolutely fight against this very old inclination to separate administrative expertise, reserved to the administration, from scientific knowledge, too often confined to the world of science.

**SCIENCES & AVENIR:** In your opinion, what are the major problems that the environment poses to scientists?

**Lalonde:** Many major questions remain unanswered. For instance, such an elementary issue as the approximate number of living species remains unknown: Estimates run from five to 30 million species, and the available estimates as to the rate of their disappearance vary from one to 10. Similarly, we have only a very limited understanding of the function of the carbon cycle, which plays a decisive role in the greenhouse effect. We cannot even determine, to within 30 years, when the obvious increase in carbon gas in the atmosphere will have visible effects on global warming. Scientists have given themselves 10 years to provide more precise answers on the climate.

Naturally, like many environment ministers, I would like to see this time frame shortened. I am also concerned by issues that are less talked about, such as the deterioration of the soil or the impact of new technologies on the environment. I am thinking particularly of biotechnology and new materials. Finally, I keep in mind that there are still many uncertainties as to the real causes of the death of forests or the long-term evolution of the ozone layer.

I would, however, insist on the fact that the environment also poses problems to scientists other than what you call "major questions." The consequences of the abandoning of agriculture in some mountain regions, the evolution of swamps in the west, the ecological situation of the major rivers, the toxicity of some chemical products used every day, these and many other subjects are ones that we would also like researchers to tackle. In addition to the indispensable major programs, we thus have to invest to a far greater extent than at present, in key disciplines such as ecology, toxicology, or economic and social sciences and substantially develop our capacities for permanent observation (as will be done with the creation of the future French Environment Institute).

**SCIENCES & AVENIR:** The scientists' time frames are not the same as the politicians'. Global warming, the hole in the ozone layer, waste disposal and storage, water pollution.... Politicians often demand answers from scientists that the latter are unable to give. How do you



handle the uncertainty without taking the scientists hostage? What then is the role of the experts?

**Lalonde:** The experts have an irreplaceable role to play: Translate scientific knowledge into information that can be used by the politicians in charge. Since they have this formidable power, their independence must be protected but it must be avoided that anybody obtains a monopoly on expertise. The pluralism of experts is an essential guarantee for the proper functioning of a democracy and I would like to see this gradually become the rule, although I am aware that this is a principle that is not always easy to implement in France. However, I have tried to apply it to the Loire improvement projects and radioactivity measurements.

Having been an expert myself, I am aware of the distance between the function of an expert and that of a politician. There always comes a moment when a decision has to be made in the face of uncertainties. Today, in view of the major hazards threatening the planet, there can be only one rule for action: Be cautious, i.e., act without having absolute certainties so as not to mortgage the future. But I am beginning to take into account political rhythms and I am trying to give citizens the means for applying pressure on the political system, regardless of who the representatives of that system may be.

#### **Renault Joins Car Recycling Effort**

91WN0489A Paris AFP SCIENCES in French  
7 May 91 pp 39-40

[Text] Marquette-Lez-Lille—Some automakers and salvagers predict that a "green," 100-percent recyclable automobile will be the rule in 10 to 15 years. In the meantime, salvagers of wrecks must find a way to reduce the 30 percent of "sterile," polluting, or nonrecoverable waste that comes out of crushers.

So Cibie Co., a Marquette-lez-Lille (a suburb of Lille) salvage company, has taken up the challenge. In collaboration with Renault and Atochem (chemicals), it has been seeking ways to shrink the mountain of waste for a year. Four hundred thousand metric tons of various materials are produced each year in France from two million crushed wrecks. "There are fewer and fewer waste grounds and prices have increased tenfold in three years, while the volume of waste is steadily growing," sums up Mr. Jean-Paul Delbert, the young president and general manager of Cibie.

The cars that are sent to the wrecking yard today average eight years in age, and were built at a time when ecology was still low on the list of manufacturer concerns. Magnetic rollers in the crushers make it possible to sort out 68 percent of the ferrous material, which is directly reusable in steelmaking. Two to three percent of the waste is nonferrous metals. The remainder (plastics, rubber, foams, and textiles) must be burned.

Cibie's employees began by meticulously stripping down 50 chassises, by hand. "The first problem was identifying

the 50 or so different kinds of plastics, which make up half of the "sterile" material," says Mr. Delbert.

The solution is now in hand, and Renault began to use it on its Clios. No more than four or five kinds of recyclable plastic are now used. Parts—bumpers, tanks, decorative strips, etc.—are marked to make them easier to disassemble and sort, operations which must be completed before the chassis is fed into the crusher.

That leaves the textiles, foams (which release chlorine gas during burning) and tires. The tires can be reduced to dust. The rubber that is extracted during the process is used to make bicycle tires or protective covering for vinestocks. The uses are minimal, however, compared to the volume of waste generated.

While Atochem and Renault ponder possible recyclable substitute materials, Cibie is investing 5 million French francs [Fr] in a pilot factory for disassembling chassises. The plant is scheduled to begin operation next fall.

The wrecks will be attached to a carousel that will have 10 stations to start with. The fluids (fuels, oils, brake fluid) and all non-metallic substances will be recovered at those stations. "Let's not talk about robotics yet," stressed the project's head, Mr. Guy Housset. "It will be a mechanized line that will use tools borrowed from various professions and adapted for our purposes."

Industrial disassembly will be the next step, with green cars designed from the moment of their construction to be destroyed. As an example, Mercedes announced last March that it had succeeded in building some cars from totally recyclable materials.

#### **France: New Dust Scrubber for Metallurgy Plants**

91WS0472B Paris L'USINE NOUVELLE in French  
13 Jun 91 p 80

[Article by Jean-Pierre Gaudard: "Usinor's 'Green' Factory"; first paragraph is L'USINE NOUVELLE introduction]

[Text] The French group has decided to do more than required by current anti-pollution regulations. Because the latter are going to play a decisive role in the future of Europe's ferroalloy industry...

Usinor Sacilor's manganese alloy plant, now under construction at Grande-Synthe near Dunkerque, is something of an experiment: The company is trying to make it as ecologically perfect as possible, and it is plowing big money into the effort. Some 20 percent of the 350 million French franc [Fr] investment is devoted to this purpose. Indeed, the entire technical and economic design of the installation is imbued with the "zero waste" objective laid out by Arnaud de Milleville, president of Seas, the company created for the occasion by Usinor, and plant manager Michel Arzalier.

The main source of potential waste is the slag that is a by-product of the ferromanganese fabrication process.

After six- to eight-month periods, this slag—which has about a 30 percent manganese content—will be used in silicomanganese production, a process which does not require such a high-grade raw material.

The heart of the factory, the electric furnace developed by Usinor Sacilor and the German manufacturer Demag, is closed—unlike the majority of furnaces in the European ferroalloy industry. With a closed oven, there is less dust emission and no combustion of carbon monoxide, thus producing a richer effluvia.

Among the most unusual features of the installation are the furnace dust scrubber and the water treatment equipment. Once the gas leaves the furnace, it is cleaned, in order to be used inside the factory to power the sintering (calcinating) unit and heat various areas. Eventually, 60 to 80 percent of the gas is thus recycled, the rest being flared. The plant's water consumption is reduced by a recycling system—with built-in redundancy for safety—and the use of cooling towers for cooling.

The water used in cleaning the gas is treated physically and chemically before being reinjected into the circuit. The dust from the settling tank, with a manganese content close to 40 percent, is transformed into "cake" by a filter press and sintered before being reinjected into the furnace. Sintering transforms the metallic dust into sinter (a sort of briquet) which, when mixed with rocky ore, optimizes furnace efficiency. Currently, the dust (30 to 50 percent of mine production) is unused, which is why the price of good-quality manganese ore has increased fourfold in the last three years. The dust is therefore less expensive. Another economic benefit: Seas's sintering and recovery operations at Ugine run on the free gas supplied by the furnace.

"Despite some additional costs, we have chosen to do more than anti-pollution regulations require, since these are bound to become even more stringent," explains Michel Arzalier. Altering an existing installation to meet new standards costs three to four times as much as the equivalent investment in a new plant. According to some estimates, operating costs for primary industries in the metals sector may increase by 20 to 50 percent between now and the year 2000.

Future legislation will doubtless play a decisive part in the restructuring of the still leaderless European ferroalloy industry. The small, independent Italian and Spanish producers will be unable to afford the heavy investments needed to bring their factories up to the new standards. Some larger groups, like Pechiney, have ruled out further investment and are trying to disengage—a prospect that worries both the metallurgists, who are afraid they may run into provisioning problems, and the miners, who fear a loss of market outlets.

In its own factory at Grande-Synthe, Usinor Sacilor is forging ahead and serving notice on those of its suppliers who might underestimate the importance of respect for the environment, which is now an integral component of industrial strategy.

### German Environment Minister Requests More Funds for New Laender

91MI0460 Bonn DIE WELT in German 2 Aug 91 p 17

[Text] Money for environmental protection: Federal Minister for the Environment Klaus Toepfer is still striving to bring environmental funding and protection to the new laender this year, in line with the West German standard. "Nevertheless," said the Minister yesterday in Berlin, "it will not be possible to remove all old sources of pollution in the former GDR within this period." He then handed over funds totaling 41.5 million German marks [DM] for eight environmental projects. With these funds, environmental investment in the eastern part of the city, totaling just DM100 million, will be possible this year. The main features of the measures funded, agreed upon by Bonn and Berlin, include making safe drinking water available, draining polluted waters, and surveying heavily polluted industrial and residential areas.

### German Research Ministry Launches Water Conservation Program

91MI0448 Bonn TECHNOLOGIE-NACHRICHTEN  
MANAGEMENT-INFORMATIONEN in German  
18 Jul 91 pp 5-6

[Text] If water conservation is to be improved, ecological strategies designed to restore the natural functioning of our rivers and lakes must be more widely applied. An improved scientific basis must be developed for these strategies which are needed to translate the Federal Nature Conservation Act into action. The priorities are:

- Further development of existing quality assessment techniques for waters (flowing waters, standing waters, and groundwater), taking account of further physical, chemical, biological, and economic regional aspects;
- Assessment of the ecological effects of the exploitation of waters (agriculture, forestry, fisheries, trade and industry, housing, traffic, leisure, recreation, water supplies;
- Measures to reduce water pollution, the drawing up of reclamation strategies, creative concepts, and close-to-nature development measures based on systems-oriented research.

The accession of the new federal laender has brought the Federal Republic of Germany new problems and tasks of water research and reclamation. Massive extraction of lignite has created enormous cavities (left behind after open-cast mining) that are gradually filling with ground water. Preventive water quality control principles must be drawn up for the resulting lakes, some of which are large and deep. There are many unknown factors regarding the nature and structure of the ground in open-cast mining holes, the nutrient content, and the plankton growth, which affect the oxygen content.

Solving the problems posed by the standing waters in the new federal laender, many of which, including reservoirs, are entrophic, requires new knowledge such as how the different types of ecosystems in lakes and reservoirs actually function. Although lake research goes back decades, it has not yet succeeded in arriving at generalizations and ecologically based management strategies merely by analyzing prevailing conditions. New environmental processes and strategies must be developed if progress is to be made in the reclamation of standing waters.

The concrete topics for standing-water research are:

- Effects of water-level fluctuations on the quality of reservoir water;
- Long-term stability of the balance of substances and the biological processes in standing-water ecosystems;
- Analysis and ecological assessment of substance and energy transfer via microorganisms in lake ecosystems.

Rivers and lakes play a decisive role in the overall ecosystem and in the global hydrologic cycle. Their ability to function naturally is endangered by the many different uses to which they are put by man. Integrated approaches are required to reclaim the polluted lakes and rivers and to enhance their natural functions again.

The BMFT [Federal Ministry of Research and Technology] is seeking to make a contribution in the form of its "water ecology" funding strategy. It covers three overall topics:

- Ecology of minor rivers, reclamation strategies for minor rivers;
- Ecology of standing waters, with a subproject on reclamation strategies;
- Groundwater pollution.

The minor rivers topic has top priority within the funding strategy.

In addition to project funding, institutional funding for water research is also being stepped up. New research facilities are being founded in Magdeburg and Berlin (East). The first session of the founding committee for the planned Institute of Aquatic Ecology and Inland Fishing in Berlin (which is to have about 100 employees) took place on 28 June, 1991. The process of founding the two institutes is scheduled for completion this year.

The BMFT is providing DM30 million in water ecology research project funding over the period 1991-1995. Institutional funding over the same period is running at about DM100 million.

#### **Germany: Ecology Institute To Be Established in Leipzig**

91MI0457 Bonn *DIE WELT* in German  
13 Aug 91 p 19

[Text] An environmental research center for particularly polluted industrial areas in the Leipzig/Halle/Bitterfeld

urban triangle was established yesterday in Leipzig. It is a joint effort involving the Federal Research Ministry, the land of Saxony-Anhalt, and the free land of Saxony. As the first large German research institute devoted exclusively to environmental research, the center will develop programs to clean up contaminated industrial land and reclaim mining sites, support the agricultural sector in introducing ecological farming methods, and demonstrate how environmental pollution in the air-soil-water interactive chain can be reduced through tropospheric research. Preliminary work on this has been performed by some 150 scientists from the former GDR Academy of Sciences and the East Berlin Agricultural Academy. The new center will begin operating at the beginning of 1992 and will later employ 400 people, which will be scientists. There are plans for the universities of Halle and Leipzig to share the existing research potential. Thus Halle-Merseburg will be involved in agricultural, geological, and biological science, in process technology and in environmental law, while Leipzig University will focus on analytical chemistry and urban ecology.

The Federal Republic will provide 90 percent of the funding (some 60 million German marks [DM] in 1992) and Saxony and Saxony-Anhalt 10 percent.

Federal Research Minister Riesenhuber was able to place top-ranking experts on the founding committee, which was established yesterday in Leipzig. Its eight members include the president of Berlin's Federal Environmental Office, Von Lersner; Director of the Alfred Wegener Institute for Polar Research Alfred Hempel; the leader of the working group for theoretical ecology at the Juelich Research Center, Jacqueline McGlade, and the general director of the EC Commission, Pasella. Wolfgang Levi (GSF, Research Center for the Environment and Health in Munich) will serve as a consultant.

#### **Germany: BMFT Funds Geothermal Plants in New Laender**

91MI0447 Bonn *TECHNOLOGIE-NACHRICHTEN*  
*MANAGEMENT-INFORMATIONEN* in German  
18 Jul 91 pp 4-5

[Text] Three geothermal plants with a total output of 22 MW<sub>(th)</sub> (thermal output) are currently running in the new federal laender. These are plants designed to exploit hydrothermal occurrences in Neubrandenburg, Waren, and Prenzlau, each of which is in a different technical stage. They are mainly being used to heat buildings and supply hot water.

Because of their interesting energy potential, the BMFT [Federal Ministry of Research and Technology] began to fund a series of research and development projects immediately after the unification of Germany. The aim was to obtain and extend the geothermal know-how of the new federal laender. Short-term grants of around 3 million German marks [DM] were allocated for this purpose.

These are the projects in detail:

- Regional studies of geothermal reserves and resources in northwest Germany. Cooperation between the NLFB [Lower Saxony Regional Office for Soil Research] and Geothermie Neubrandenburg GmbH. BMFT funding of DM1.165 million corresponds to 70 percent.
- Comparative location study with calculation of economic viability. Cooperation between Geothermie Neubrandenburg GmbH and Energieconsulting of Heidelberg GmbH and the Rheinland-Westphalia Electricity Work [RWE]. BMFT funding of DM196,000 equals 100 percent.
- Geothermal charting work: Environmental and Economic Geology Corporation, Berlin. BMFT funding of DM932,000 equals 100 percent.
- Energy supply system taking account of the geothermal resources in the town of Neustadt-Glewe. Heating Systems Installation Company, Berlin. BMFT funding of DM170,000 corresponds to 90 percent.
- Geological and process engineering studies with a view to utilizing geothermal energy: Geothermie Neubrandenburg GmbH. BMFT funding of DM960,000 corresponds to 80 percent.

The aim of the projects funded is to work out as quickly as possible investment decisions for modernizing old plants as well as bases for building new ones. The prime contractor to erect and operate the plants, necessary before the work can continue, has yet to be named.

Based on the findings of a technical conference on geothermal science that took place in Berlin in April of this year, operation that is close to economical can be expected if geothermal plants are integrated into the basic load of local authority supply systems with more than 5,000 full-load hours per year. Concrete decisions by the local authority utilities concerned in the new federal laender, some of which are in the establishment phase, are needed.

BMFT decisions to fund pilot plants are expected to be based on the results of a comparison of locations and economic projections, which are to be presented this year. A particular problem in this regard is that of the salinity (salt content) of the warm ground water.

Apart from hydrothermal utilization, the opening up of geothermal energy at great depth must also be assessed. A priority of BMFT funding in the past few years has been the HDR [Hot Dry Rock] technique: cold water is injected into the hot substratum through injection drilling, where it circulates, heats up, and is fed to a power station via a second drilling in the earth's surface. At the beginning of 1990, it was possible to integrate European efforts under the guidance of Siemens and with the participation of additional German companies

into a European consortium. Along with the EC Commission, France (BRGM [Geological and Mining Research Office]), and Great Britain (RTZ Consultants Ltd) also belong to the consortium.

The HDR project pursues the objective of opening up geothermal potential largely independent of location. Bad Urach (Germany), Soultz Sous Forets (France), and Cornwall (UK) are under discussion as possible locations for a pilot plant.

Projects for developing HDR technology are also being carried out in the U.S. and Japan; the exchange of scientific information is to be increased. In the past 15 years, geothermal science has been funded by the BMFT with about DM75 million; in 1990 over DM6 million will be spent.

Geothermal energy has the potential to cover the energy requirements of mankind over very long periods. The potential of the top seven kilometers of the earth's crust, which can be reached using the current level of drilling technology, is so large that it seems worth exploiting more intensively. Geothermal power stations have been installed in over ten countries and contribute to supplying more than 3.2 million people. The total capacity of these power stations is currently around 5,800 MW (electrical) and 11,400 MW (thermal). In France alone some 200,000 apartments are being supplied with thermal energy from geological heating plants. Certainly the use of geothermal energy depends on geological and tectonic conditions, which are easier to evaluate at many places abroad than in the Federal Republic, including Iceland, Japan, the Philippines, and the U.S.

#### Possible Alternative Energy Source Found in Weed

91WS0433 Berlin *ING DIGEST* in German Jun 91  
pp 43-44

[Article: "New Opportunity in an Herb"; first paragraph is *ING DIGEST* introduction]

[Text] We have a remedy for oil crises and the greenhouse effect: an herb, in the truest sense of the word. This herb is not the beautiful blue rapeseed, but rather china reed. Insiders are calling this raw material the energy source of the future. Is there enough land in the new German laender for china reed to be planted? Dr. Friedrich Stegmann, of KDT Association of Agricultural Engineering, Forest Engineering, and Food Engineering, had the following to say.

Man has long used renewable resources as industrial and energy crops. When materials or fibers are leached from the harvested plant's tissue and made into chemical raw materials, the plants from which they are leached are known as "industrial crops." When the entire plant or parts of it is used to produce energy via subsequent conversion steps such as drying by pressing, fermentation, or combustion, these plants are known as "energy crops." Some plants or raw materials such as sugar,

starch, and oils can be used as both industrial and energy crops. Residual and waste products from other agricultural processes also provide raw materials, and are used in the production of biogas. One example of this is animal fat. Since the middle of the nineteen seventies, the use of renewable resources has been widely and frequently discussed. The impetus for this was twofold: first of all, the 1973 and 1979 increases in the price of oil combined with a marked upswing in the cost of fossil fuels; secondly, continued warnings by scientists that our fossil fuel resources are finite. As a result, energy policies were an important element in the first phase of the discussion on renewable resources.

The second phase of this discussion began in the early eighties: surpluses in the food market and the emerging agricultural crisis intensified the demands by the agricultural industry for alternative uses for economically produced products made from renewable resources.

The declining demand for raw materials of agricultural origin was due in large part to the increasing importance of petrochemistry and to changes in industry. Increasingly inexpensive fossil fuels and petrochemical raw materials were used in the place of expensive renewable energy sources and industrial raw materials of agricultural origin. Because animal power had given way to machine power, fields which had formerly been used for fodder were freed for foodstuffs. Advances in the petrochemical field spurred the use of fertilizers and insecticides. Furthermore, during the early years of the EC, a swift increase in the production of foodstuffs was desirable, first of all, because more food was needed to feed the rapidly expanding population, and secondly, as a precaution against future crises. At the same time, an agricultural policy which favored protectionism via domestic price supports contributed greatly to overproduction. This, however, increased the burden on the EC budget. At this point, there was a reawakening of interest in the original functions of agriculture: the simultaneous production of raw materials, energy sources, and foodstuffs.

During the past few years, the chemical industry has also expressed interest in using domestically produced renewable resources. Approximately 10 percent of the chemical industry's organic raw material requirement is supplied by domestic concerns; the remaining 90 percent is imported from overseas. Consequently, the purposeful production of renewable resources has the potential to open new markets for the local agricultural industry. This would also serve to increase the production of environmentally safe (biologically degradable) products, thereby reducing the load on the environment. Finally, integrating the cultivation of crops that yield raw materials into the crop rotation would lengthen the rotation.

The increasing CO<sub>2</sub> content of the atmosphere and potential climatic changes (the greenhouse effect) are lending a new urgency to discussions of renewable resources as an integral part of a strategy to reduce the

use of fossil fuels. The discussions center around so-called C<sub>4</sub> plants. In the first phase of photosynthesis, these plants produce four carbon atoms instead of three, as do most useful plants. At the same time, they fix the CO<sub>2</sub> that they have used rather than releasing it back into the atmosphere as do C<sub>3</sub> plants. One such efficient user of solar energy is miscanthus, also known as elephant grass and, in its hardy form, china reed. This plentiful C<sub>4</sub> plant is native to China, but can also be successfully grown in our part of the world. It requires almost no fertilizer and very little water. Once planted, it returns each year and yields up to 40 metric tons dry measure per hectare.

The cultivation of C<sub>4</sub> plants is an alternative to letting fields lay fallow as a means of earning money. The raw material can be made into construction material, biologically degradable packing material, gasoline, or sources of heat. Once separated from the pith, the fibers can be combined into sheets. Manufactured under high pressure, these sheets are strong and can be used as a substitute for synthetic shipping materials, for kitchen appliances, for example. Combined with epoxy resin, they can also be used as a substitute for sheet-metal sheathing for automobiles. "Scrapping" presents no problem: after the material has been shredded, fungus and bacteria attack the fractures and turn it into humus.

As a powder, the material can be used in the combustion chamber of a turbine to produce electricity, or it can be gasified to produce chemical products such as synthetic materials, fertilizers, gasoline, etc. Gasifying the material is an economical means of producing synthesis gas (carbon monoxide or hydrogen), which is used with cellulite to produce gasoline or gasoline-like products. A 40-metric ton per hectare harvest of biomass yields 12 metric tons of gasoline.

The VEBA-OIL Concern is presently conducting tests on the production of paper via gasification of hydrogen, using synthesis gas, gasoline, and chemical raw materials, and via cellulose fusion. Hubert Heuneka, VEBA chairman of the board comments: "This could be a short-term application." If it were possible to extract oil out of a synthesis gas of C<sub>4</sub> material, it would be about four times cheaper than obtaining it from rapeseed. This brings up another advantage of vegetable oils and vegetable gasolines: There is no CO<sub>2</sub> problem, and thus no contribution to the greenhouse effect and no adverse effect on the climate. In addition, Bavarian Motor Works (BMW) states that gasoline made of biomass is not only CO<sub>2</sub>-neutral, but also economical. Under the most favorable circumstances, the cost would be 1.397 German marks [DM] per liter.

It remains to be seen whether we have found an ideal solution in vegetable raw materials. Nonetheless, a lobby in the European Parliament has already succeeded in having DM300 million allocated to increasing our knowledge of them. How environmentally safe is china weed? The Federal Institute for Agricultural Research has been researching this question for two years. There is

little need for fertilizers, as the leaves of the plant fall off and serve as sources of nutrition. Packing material that was made out of the plant and later buried in the ground dissolved into humus after one month. Cases for certain products can also be manufactured from the biomass and later be recycled as animal fodder. Finally, biomass is the most economical substitute for synthetics, and would be a cash crop for farmers.

The cultivation of C<sub>4</sub> plants in the new German laender shows great promise. It could combine ecological, landscaping, and economic factors. Our task now is to find interested parties to cultivate the plants and market the harvest. By doing so, the Federal Republic of Germany could assume a leading roll in the EC. The KDT Association of Agricultural Engineering, Forest Engineering, and Food Engineering wants to support these goals and to use its resources to encourage the development of communities of interest for "biomass cultivation and marketing."

### **EUROTRAC Ozone Research Project Findings Reported**

#### **Emission Reduction Urged**

91MI0450A Bonn *TECHNOLOGIE-NACHRICHTEN*  
*MANAGEMENT-INFORMATIONEN in German*  
18 Jul 91 pp 23-24

[Text] An environmental problem that has been much discussed in recent years surfaced during this last period of hot weather: smog, which forms in the lower atmosphere as a result of greaten as much as four times as high as previously in the summer daytime. Historical data also show that there was no summer smog 100 years ago.

Air chemists from more than 10 countries have joined forces to study the ozone balance in lthe troposphere (the lowest 10 km of the earth's atmosphere). The main purpose of the TOR [Tropospheric Ozone Research] project is the quantitative examination of summer smog in rural areas of Europe.

TOR is based at research stations in selected regions where the quantitative experimental foundation for an understanding of the ozone balance will be laid using advanced and largely newly-developed analysis equipment, part of which has been developed specifically for this project. The network of research stations stretches from Spitzbergen in the north to Tenerife in the south. The BMFT [Federal Ministry of Research and Technology] is currently financing five projects as part of TOR for a total of 7 million German marks [DM] from 1988 through 1992.

The results that have been achieved to date under this project are of primary importance for a quantitative understanding of photosmog. Comparison of this data, obtained purely by experiment, with model results show a high degree of consistency. However, there are already indications that the models are not capabale of giving an

adequate description of the complex problems of photosmog. Measures to reduce urban and rural ozone pollution should be based on model predictions confirmed by experimental data. The TOR project will provide the requisite data base.

Ozone is an important componenet of the earth's atmosphere. It protects us from high energy and life-endangering ultraviolet solar radiation. The prime responsibility for this protection is borne by the ozone layer in the stratosphere at a height of some 30 km. As the "ozone hole" phenomenon has clearly shown, this protective layer is endangered through the use of CFC's [chloroflourocarbons] in propellant gases and coolants.

The situation is completely different in the lower atmosphere. On the earth's surface, ozone makes its presence felt adversely owing to its toxicity. Ozone has a destructive effect on the cell components of plants, animals, and humans. Because of its low solubility in water, it enters the lungs and affects the very area where the vital oxygen exchange takes place between air and the blood. However, the ozone concentrations observable at present in the lower troposphere are still considerably below the threshold value, above which serious and lasting damage would be caused to healthy persons.

Ozone is formed under the influence of sunlight, therefore mainly in summer, in good weather, when chemical reactions (in this case photochemical oxidation with hydrocarbons and carbon monoxide) take place in the presence of nitrogen oxides.

Hydrocarbons are emitted into the atmosphere by a variety of anthropogenic and natural processes. The automobile and the petrochemical industry are significant sources. But industrial emissions, the use of solvents, and domestic heating also make considerable contributions.

However, the major emitters of nitrogen oxides, which play a key role in ozone production, remain automobile traffic, domestic heating, and large-scale furnaces (non nuclear electricity generation).

Once formed, the ozone can be carried over great distances and be detrimental to the air quality in areas far from the point of emission. An important point is that already-increased ozone values foster further ozone production. The highest ozone levels are usually recorded in rural areas where the ozone and its precursor substances have been transported by the air circulation from their place of origin, the congested urban areas. Exceptions are cities where the petrochemical industry is highly developed; peak values of several hundred micrograms of ozone per cubic meter have occasionally been registered in such areas for relatively short periods.

While the processes that lead to the production of summer smog are known qualitatively, the quantitative composition is problematic. This is because the source strengths of the primary ozone components are not

known with sufficient accuracy. The necessary concentrations of primary products required for a description of the ozone balance have only become measurable in the atmosphere very recently and with very expensive experiments. There are possibly also still chemical processes in the atmosphere that have not yet been detected in laboratory experiments or which could not be correctly simulated.

In any case, strategies for the reduction of materials that cause ozone production must be applied in the congested urban areas. The emission reduction measures in industry and the introduction of catalytic converters can make an important contribution. Further measures are necessary to achieve a reduction in emission rates of one-third to one-fourth of their present values. A solid experimental data base, such as that acquired in the TOR project, is the fundamental requirement for extensive measures.

Further information can be obtained from: Dr. D. Kley, TOR Project Coordinator, KFA Juelich, P.O. Box 19 13, 5170 Juelich. Tel: 02461/61-3741.

#### Lower Butene-1 Concentration

91MI0450B Bonn *TECHNOLOGIE-NACHRICHTEN*  
*MANAGEMENT-INFORMATIONEN* in German  
18 Jul 91 p 27

[Text] Research studies of the European TOR [Tropospheric Ozone Research] project have made an interesting discovery: the concentration of the hydrocarbon compound butene-1 is falling, according to the Schauinsel measurement station in the southern Black Forest. This was reported in an interim review by Dr. Dieter Kley, director of the Institute for Chemistry of the Polluted Atmosphere at the Juelich Research Center, and TOR project coordinator.

Although a series of measurements covering two and a half years is not sufficient to confirm the observed trend, if it proves to be correct, the peak ozone pollution in Germany could decline in the future.

The Juelich Research Center has been operating the Schauinsel measurement station since 1988. Here, butene-1 hydrocarbons, along with other, mostly anthropogenically emitted (caused by humans) hydrocarbons, have been observed with an automatic gas chromatograph.

The hydrocarbon compound butene-1 is very reactive in the atmosphere and it degrades quickly there. It originates mainly from automobile traffic. Butene-1 is a very effective producer of ozone, one of the most important molecules in the generation of summer smog. Southwest Germany, and especially the Upper Rhine valley, is particularly affected every year by summer smog. Peak values of 250 milligrams of ozone per cubic meter air are not uncommon on warm summer days in cities on the

Upper Rhine. Nor are the peak concentrations much less in the rural areas. Butene-1 also contributes to this peak pollution.

In past years, the observed drop in concentration indicates that the progressive equipping of automobiles with controlled three-way catalytic converters is achieving the desired effect. However, according to Dr. Kley, the ozone peak pollution will only fall if the observed emission drop of butene-1, and presumably also of other hydrocarbons, is not counteracted by an increase in traffic volume.

The European TOR research project is subsidized by the Federal Ministry for Research and Technology (BMFT).

#### Swedish Waste Incinerators Supply Heat for District Grids

91MI0449 Bonn *TECHNOLOGIE-NACHRICHTEN*  
*MANAGEMENT-INFORMATIONEN* in German  
18 Jul 91 pp 9-10

[Text] The compulsory recycling of waste paper proposed in the Regulation on Waste Paper would cause the current surplus of waste paper to grow even larger, according to President of the Federal Association of Printing Hans-Otto Reppekus in his 1990 Annual Report. Despite increasing recycling, it is not possible for the papermaking industry to reuse all waste paper.

Reppekus pleaded for paper and packaging waste to be incinerated on the Swedish model, instead of just dumping it onto the growing mountains of refuse. Not only is the development of special power stations for waste paper being considered there, more than half the annual volume of household refuse (of just under three million tonnes) is being burned in 23 district heating stations. In contrast, 70 percent of the household refuse in the old German laender still finds its way to the dump.

In contrast to the Federal Republic, the Swedes, who have practically no natural gas, do not just use refuse incineration to reduce their dependence on oil and coal. Since, according to information from the paper-making company STORA, two tonnes of packaging material correspond in heat value to one tonne of oil, and since 40 percent of household refuse by weight consists of paper waste, the Swedes currently heat 250,000 flats with thermal energy from household refuse. The largest of the 23 refuse-fired works, with an incineration capacity of 200,000 tonnes of household refuse per year, are in Uppsala, Gothenburg, Malmö, Linköping, and Stockholm. Gothenburg already supplies 60,000 flats with hot water and 30,000 with electrical energy by burning refuse; it wants to double its combustion capacity by 1994 and increase it to 400,000 tonnes per year.

The city of Uppsala has been covering the heat requirements of 95 percent of its households by burning household waste since 1985. Because Uppsala (which has only 160,000 inhabitants) does not produce enough refuse, other local authorities within a radius of 95 kilometers



deliver theirs to the energy-supply utility Uppsala Energi AB. The price paid by Uppsala Energi for a tonne of household waste depends on the amount of sorting required. Last year it was the equivalent of 13 German marks [DM], it is currently only about DM4 per tonne. As of 1992, the local authorities will be supplying their waste even for no fee because they will save dumping costs. The households connected to the district heating network (some 110,000 units) benefit from the disposal costs saved.

Thus the Swedish population accepted this type of refuse processing, although after initial resistance. According to Managing Director of Uppsala Energi Lars Astrand, even the Swedish Greens may now have come around to acceptance. The Swedish wood-processing industry, hence the cellulose, paper, and packaging manufacturers, is in favor of burning household waste because the high proportion of paper and packaging waste that it contains provides a valuable biofuel, just like all waste paper that cannot be reused. Finally, a paper fiber may only be reused three or four times, even with corresponding deterioration in product quality, stresses Dr. Alexander Donetzhuber of STORA Technik AB. Seen this way, it is impossible to avoid the question of what is to be done with paper and packaging waste, even despite ingenious recycling techniques. Burning may be better than dumping in any case.

The VDI [German Association of Engineers] meeting on questions of waste combustion in Essen on June 19, concluded that: waste incineration plants reduce waste up to about one-tenth of the volume, preclude the hazard of large-area pollutant distribution presented by other techniques, and utilize energy released for power generation or district heating. In this way, some 200 kg of mineralized, reusable ash which could be used as building material is obtained per tonne of waste. For example, the waste-burning plant in Uppsala annually sells considerable quantities of slag as building materials. The Essen VDI meeting also confirmed that the heavy metals, salts, and pollutant-loaded flue dusts can currently be processed to such an extent as to leave a residual quantity of only 3 kg of material to be disposed of from one tonne of household waste.

The emission guidelines in Sweden for new refuse-incineration plants are just as strict as in Germany (including a dioxine limit of 0.1 nanogram/m<sup>3</sup>). "This means that refuse incineration is nowadays a dioxine destroyer and no longer a dioxine producer," says Uppsala Energi boss Astrand. Technology Director Mats Karlsson of GRAAB [Gothenburg Waste Processing Company] adds, "A hundred times as much dioxine arises in dumping refuse as in burning it."

#### **Sweden Expands Use of Waste Combustion as Alternate Energy Source**

91WS0477A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 11 Jul 91 p 8

[Article: "Sweden Hopes To Expand Use of Waste Combustion for Energy Gain: Residue Can Be Used as Building Material; Increased Acceptance by Population"]

[Text] Frankfurt, 10 July—Instead of dumping paper and packing waste on already towering mountains of trash, Sweden is considering the development of special power stations for used paper, and even today far more than half of the annual domestic waste total of just on 3 million tonnes is being burned in 23 central-heating plants. If we compare this with the old federal Laender of Germany; here 70 percent of domestic waste ends up on the dump.

In contrast to the FRG, Sweden has virtually no natural gas. The Swedes use waste combustion at least in part to decrease their dependence on oil and coal. Since, according to data from the Swedish paper firm Stora, two tonnes of packing material correspond to one tonne of oil, and almost 40 percent of household waste by weight consists of paper trash. Swedes are already heating 250,000 homes with thermal energy from household waste.

The largest of the 23 waste combustion plants, with a burn capacity of over 200,000 tonnes annually, operate in Uppsala, Goteborg, Malmo, Linkoping, and Stockholm. Goteborg, which already provides 60,000 homes with hot water and 30,000 with electricity, hopes to double its burn capability by 1994, expanding it to 400,000 tonnes annually. The city of Uppsala has been meeting 95 percent of domestic heat demands from waste combustion. Because the waste production of the Uppsala community, numbering only 160,000, is too small. Other communities within a range of 75 km deliver their wastes to the energy-providing firm of Uppsala Energi AB. Last year, the firm paid the equivalent of 12 German marks [DM] for a tonne of waste, depending on the degree of presorting, but today they pay only about DM4. Starting in 1992, the communities will even deliver their waste free of charge, because it saves disposal costs. Households connected to the central-heating plant network, approximately 110,000 persons, profit from the reduced running costs.

After initial opposition, the Swedish populace is also accepting waste combustion. According to claims by Lars Astrand, business manager of the Uppsala Energi company, even the Swedish Greens now support it. The Swedish wood processing industry, i.e., the producers of cellulose, paper and packing, savor household waste combustion, if only because the high proportion of paper and packing wastes contained in it, along with all kinds of nonrecyclable used paper, produce a valuable biological fuel. After all, a fiber of paper can only be recycled approximately three or four times, even with a corresponding reduction in product quality.

A VDI [Union of German Engineers] conference on questions of waste combustion recently held in Essen also concluded that waste combustion plants reduce the volume of waste yield to approximately one-tenth, eliminate the danger of large-scale distribution of toxins which other processes entail, and exploit the energy released to provide electricity and central heating plants. In the process, approximately 200 kg of mineralized and



reusable ash, which can function as a building material, is produced by every tonne of waste.

The waste combustion plant in Uppsala, for example, sells significant amounts of residue annually as a building material. The heavy metals, salts and fine toxic dust produced in domestic waste combustion can now be processed to the point that from a tonne of household waste the residue which has to be disposed of by other means comes to no more than 3 kg. The emissions guidelines for new waste combustion plants are just as strict in Sweden as in the FRG.

## FACTORY AUTOMATION, ROBOTICS

### EUREKA Factory Automation Project Progress Reported

91WS0466H Brussels EUREKA NEWS in English  
19 Jun 91 p 12

[Article: "PARADI: A New Approach to Production Management"; first paragraph is EUREKA NEWS introduction]

[Text] Many manufacturing plants across Europe face similar problems in optimising their production processes, and with the prospect of stronger European competition only one and a half years away, solving them will become even more important. In March this year, at Aerospatiale's Bourges site in the heart of France, participants in PARADI, EUREKA Project EU 21, demonstrated prototype software packages that promise to tackle these common problems, and help European Industry meet the challenge of 1992 and beyond ...

How best to coordinate component production to reduce waiting times, meet due dates and optimise the use of resources? The answer has been known for some time: provide better decision-making and planning at all stages of production, from the "Master Schedule" that looks years into the future, down to the day by day processes of the workshop. But how can this be achieved?

The answer, according to PARADI, is to redesign the planning process and develop expert systems to help production managers make the right decisions. "PARADI is an information system for production management, using planning and simulation tools for decision support," explains Dominique Gay, of Aerospatiale. "It is based on the concept of CIM, or Computer Integrated Manufacturing, and is innovative in the way it divides the planning process into Long, Medium and Short Term stages."

#### Expert Systems Help Manage the Load

The accompanying schematic outlines the PARADI three-level approach to production planning. At each level PARADI software modules—user-friendly, PC-based expert systems—provide managers with decision support, helping them choose the right course. PARADI

also provides sophisticated monitoring of the actual production status at each level, so that decision makers are always fully informed.

Of great interest is the reduction of lead times (a perennial problem in modern manufacturing), and avoiding bottlenecks in production, resource shortages or overloads on certain machines. These problems are particularly acute in the manufacturing of high technology products with many components.

Some prototypes of PARADI software are currently being tested in "pilot sites", factory workshops run by PARADI participants in France, Italy and Spain. Between them, these factories manufacture a wide range of complex products, from aircraft sub-assemblies to car body tooling systems to missiles.

"It is very important to use pilot sites in order to produce real world data for testing and validating the software prototypes," maintains Mr. Gay. "The packages will be developed into finished products for use at these sites, and then marketed throughout Europe. And as PARADI is a modular system, the market will not be limited to big companies such as Aerospatiale and Alenia—smaller companies will be able to buy individual software modules, and then customise them to their specific needs."

#### Competitiveness Through Cooperation

This range of small to large companies in the market is reflected in PARADI's membership list as well. Although there are several major European industrial producers such as Aerospatiale involved in the project, contributions from smaller software companies have also been significant. Through cooperating in the 25 MECU, 6 year project, the participants have developed a common "technological language" that has aided communication between managers, engineers and technicians from France, Italy, Spain and Belgium.

"The synergy created by exchanges between different cultures and management practices has meant that PARADI benefits from a blend of the best ideas developed by European industry," explained Mr. Gay. "Having the EUREKA label has not only meant that partners have received funding from their governments, but also that the end product will be more applicable to a greater part of the European market."

"PARADI demonstrates the capability of a European team to reach a target together," commented Mr. le Corviger, manager of the Bourges plant. "Flexible production management will be vital in countering the increasing competition from Asia and Japan. I believe PARADI will give us the competitive edge we will need."

### France: Aerospatiale Specializes Plants To Improve Production

91WS0473C Paris L'USINE NOUVELLE in French  
20 Jun 91 pp 75-76

[Article by Paul Pascal: "Aerospatiale Specializes Its Airplane Factories"; first paragraph is L'USINE NOUVELLE introduction]

[Text] The production lines are picking up speed. In 1993, they will have to manufacture one airplane a day. A move to rationalize production is in full swing.

With the airplane division's four sites being specialized to rationalize production, Aerospatiale is astir with a combat-like bustle. "Besides composite materials, Nantes is now the production center for all block-cut parts over 710 millimeters, for use primarily in the wing-to-fuselage attachment of the Airbus, ATR (regional transport plane) 42s, and ATR 72s," says Jean-Michel Bardot, production manager.

This division of labor is meant to boost production to 30,000 parts by next year, or three times more than in 1988. To achieve that goal, the new plant, christened Emerald, is equipped with 23 mobile gantries run by direct numerical control (DNC). Each of them is equipped with two to four millers that pivot around three, four, or five axes. The latter control the movement of the milling cutters along benches that can be as long as 54 meters.

The raw material used consists of thick sheet metal or blanks forged of a light alloy of aluminum and copper. Designed by Pechiney, the alloy has a strength of 50 kg/square mm. Moreover, an underground network directly ships the chips to the compacting site. Each month 350 metric tons of waste—75 percent of the raw material—are sold for retreatment.

The machining programs are written at Nantes on 12 CAMD (computer-assisted manufacturing and design) stations, then stored on the central computer before being remotely loaded in-house. The Toulouse Center designates only the technical specifications.

In the middle of the shop floor, the control room centralizes information on the status of the stock and distributes the tasks to be performed. On each machine, a single operator receives the instructions: the part to be made, the blank to be placed on the bench, and the tool to attach to the machining head. One hundred and fifty operators and 70 technicians and foremen have been assigned to these new jobs. The plant, organized to function in three eight-hour shifts, operates seven days a week.

The whole operation was a huge makeover that required a total investment of 200 million French francs [Fr] for the Nantes factory, where the real value of the stock totals Fr400 million. Indeed, seven gantries from the Sainte-Nazaire and Meaulte (Somme) sites were transplanted. The Nantes division, which thus far had 13

machines, has just purchased only seven, three of which have already been delivered.

On the other hand, the infrastructure work proved to be much more extensive than expected. The shop's surface area nearly doubled: It takes up 22,000 squares meters of space. A slab of concrete measuring over 4,000 cubic meters provides a perfect foundation for the whole thing.

The first measurable result of the arrival of computers in the shop is that chip production took up 60 percent of the machines' real operating time in 1990, compared to 43 percent in 1986. And when the 27 machines to be installed are in full gear in 1993, managers are aiming for 65 percent. Even at that rate, it will take another three years for Nantes Aerospatiale to honor its back orders (in particular, 500 Airbus A320s).

## LASERS, SENSORS, OPTICS

### Alcatel To Produce Own Optoelectronic Components

91WS0483A Paris L'USINE NOUVELLE in French  
18 Jul 91 p 40

[Article by Jean-Pierre Jolivet: "Toward Mass Production of Optronic Components"; first paragraph is L'USINE NOUVELLE introduction]

[Text] Alcatel-CIT has already benefited from a technology transfer. The company is developing a line of semiconductor lasers.

Wide-band telecommunications networks, videophones, and access to animated, high-definition image banks: The soothsayers predict that the nineties will be the decade of optical communications. For this to come true, however, the manufacture of optronic semiconductors—the chips that transform the electron current into a light flow and vice-versa—will have to keep pace. Today production is calculated in only thousands of units. The industry will have to step up to long production runs at costs compatible with market laws.

That step will be made possible by CNET (National Telecommunications Studies Center), which has just developed a vapor-phase epitaxy process that enables telecommunications optronic components (lasers, photodetectors, and other modulators) to be mass produced.

The technique was developed in the laboratories of the Bagneux Center. It uses deposits of very thin films

(ranging from 30-40 nanometers to a few microns) of indium phosphide-based semiconductor materials on a large substrate (5 cm in diameter). The process makes it possible to manufacture films whose thicknesses are almost perfectly homogenous. Reproducibility is also improved, enabling several thousand components to be produced simultaneously. The result is better output. Moreover, these results propel CNET to the top internationally, with the manufacture of a InGaAsP laser whose threshold current is under 1.7 mA—a first in Europe! Such performances would not have been possible without the development of a new epitaxy reactor concept, called a "T" design. The system allows the gases to flow rapidly and parallel to the substrate. The transitions between layers of different composition are very clear-cut, and the layer thicknesses can be controlled to nearly 1 percent over the entire surface. The result is less heating and hence a longer life, a characteristic that is now deemed vital by manufacturers of undersea telecommunications links. At the same time, precise control of the growth temperature, which is critical for InGaAsP alloys, makes it possible to guarantee the precision of the wavelength emitted. Finally, the CNET researchers' solutions have given rise to a process of growth under atmospheric pressure that curtails production costs—particularly costs related to maintenance and the use of chemical agents.

Today knowledge of the process, which is protected by four patents, has been transferred to Alcatel-CIT. The company is developing a line of semiconductor lasers based on the technology. CNET has also sold the license for its epitaxy reactor to Meca2000 which, in association with another small company, Efferel, will handle its manufacture and marketing.

The latter are two technology transfers that fit well into the new role CNET has chosen for itself—that of lending support to semiconductor manufacturers in the face of the Japanese threat.

## MICROELECTRONICS

### JESSI To Shift Emphasis to Market-Oriented Projects

91AN0502 Amsterdam *COMPUTABLE* in Dutch  
5 Jul 91 p 7

[Article by *COMPUTABLE* correspondent: "JESSI Research To Become Less 'Fundamental'; Research Projects More Market-Oriented"]

[Text] The Hague—Under the pressure of the EC ministers, the Joint European Submicron Silicon Initiative (JESSI) will focus less on fundamental and long-term research [fourth subprogram]. This was decided by common agreement between "Brussels" and the JESSI Board. A number of projects falling under the fourth subprogram will be canceled, postponed, or continued under a different EC program.

It was decided that JESSI should put more emphasis on "integrated projects" that are closer to the market, such as the design of chips for high-definition television (HDTV) and of application-specific integrated circuits (ASIC's) for telecommunications. The increased activity in ASIC development will adversely affect the development of static random-access memory chips (SRAM's). Minister J.E. Andriessen [Dutch minister of education and science] announced this rather unexpected shift in the JESSI program after the EUREKA [European Research Coordination Agency] ministerial conference. This shift of emphasis will give Philips a reason to step up its involvement in JESSI.

According to Dutch member of parliament (MP) W.J. van Gelder (PVDA, Labor Party), who presides the standing parliamentary committee for scientific research, the report drawn up by the British researcher Oakley had a great impact on the decision to thoroughly readjust JESSI. Oakley was requested by the Dutch Government to examine the role that Dutch scientific institutes could play in the field of microelectronics. The government commissioned this "Netherlands Microelectronics Policy Study" as a result of Philips' decision to discontinue mass production of memory chips. The British researcher concluded that a number of projects deserved support, but at the same time he found that JESSI included several projects, which had hardly anything to do with program. This will be the very type of project that will be removed from JESSI altogether, or at least delayed.

In recent months, there has been a tendency among subsidy-granting authorities to control large-scale projects such as JESSI more strictly. Although the purpose is not to impose the policy to be followed from above, a minimum of coordination is considered necessary. Van Gelder is pleased with the fact that project content has now become an explicit criterion. The Brussels-based EC is showing more interest in JESSI, since it is increasingly being called upon to pump money into the program. The EC had growing doubts about the rightness of the JESSI approach. The downsizing of the subprogram for long-term research also avoids an excessive fragmentation of the program.

The recent changes to JESSI come on top of a long series of previous adjustments and policy reversals. Throughout the lengthy preliminary phase, the program became increasingly ambitious. Initially intended as a sort of follow-up to Siemens' and Philips' megachip project, JESSI gradually adopted gigantic proportions. JESSI was expected to bring Europe up to a par with Japan in the field of microelectronics.

As the preliminary phase was developing, a discussion arose about the question of whether this goal could best be achieved by keeping JESSI purely European, or by teaming up with American and Japanese companies. Initially, it seemed that preference was given to an exclusively European approach, but this did not prevent some of the major participants to enter into alliances

with non-European companies. Siemens, for instance, purchased know-how from Toshiba, while the British computer manufacturer ICL purchased chips from Fujitsu. Later on, ICL had become so dependent on Fujitsu, that it was taken over by the latter.

Now that Philips, too, is negotiating with IBM about the possible purchase of advanced chips, this recent trend seems to be virtually irreversible. The French Government is the only one to insist strongly on JESSI's exclusively European character. Labor MP Van Gelder thinks that European JESSI participants should be allowed to cooperate with non-European companies, provided that this cooperation occurs on terms of equality. He argues that such a cooperation is preferable to simply purchasing knowledge from America or Japan, as Siemens and others were doing in the past. "By doing so, your fate is still in their hands," says Van Gelder.

#### [Box]

#### 16-Mb EPROM

The JESSI memory project reached a landmark with the introduction of a 16-Mb erasable programmable read-only memory (EPROM). The announcement comes one year after the introduction of the 16-Mb dynamic random-access memory (DRAM) in the JESSI program. Siemens is responsible for the DRAM memory, whereas SGS Thomson is in charge of the EPROM memory. According to a JESSI spokesman, the result now achieved justified the high expectations aroused by the entire project. Although the JESSI program continues until 1996, next year will be the most crucial phase in its existence.

#### SGS-Thomson Creates Animated Image Compression Microprocessor

91WS0425B Paris INDUSTRIES ET TECHNIQUES  
in French 14 Jun 91 p 108

[Article by Ridha Loukil: "Animated Image Compression"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] A single chip performs this vital video operation. It will probably find its first applications in videophone and videoconference technology...

With SGS-Thomson's STi3220 movement-estimation processor, motion imagery moves into the era of color and digitization. An outgrowth of CMOS [complementary metal-oxide semiconductor] technology, this integrated circuit with 260,000 transistors provides the crucial video-signal encoding/decoding systems for such applications as videophone, videoconferencing and high-definition television [HDTV]. Its function is to compress the signal by reducing the enormous volume of digital data required for storage or transmission of color images. Compression is accomplished by eliminating information that is redundant or has no effect on image quality.

#### Storage Capacity

The STi3220 is a more advanced version of the STi3208 discrete cosine transform (DCT) chip that was specially designed for the compression of still images. The DCT function eliminates data not needed for updating the screen. With a compression ratio of 25:1 (eliminating 96 percent of the data), the difference between the original and the compressed image is imperceptible to the naked eye. The movement estimator takes advantage of the redundancy and similarity of successive images, which are often composed of the same elements arrayed in a slightly different way. The movement estimator transmits only information reflecting these changes. Combined with the DCT function, it yields a compression ratio of 200:1 (which eliminates 99.5 percent of the data), without visible degrading of the image.

Compression of moving images requires enormous real-time processing power. It takes a high-performance dedicated processor to meet the need. Composed of 256 parallel processors, the STi3220 performs 14 billion operations per second. At that speed it can remain in phase with the video turnover frequency of 30 images per second.

The new chip conforms to the H261 standard set by CCITT/ISO [International Telegraph and Telephone Consultative Committee/Open Systems Interconnection] for videophone and videoconferencing. It also meets the international MPEG (Motion Pictures Experts Group) standard regulating other motion-image applications. With this processor, an entire hour of video can be stored on a CD-ROM [read-only memory] compact disk—versus only three minutes without compression.

SGS-Thomson is working on a chip that will integrate all the functions required for still-image compression in the JPEG (Joint Photographic Experts Group) mode. The future chip will require only a microprocessor and static RAM [random access memory] to handle all encoding and decoding for applications such as digital cameras, telecopiers, photocopiers, laser printers, and multimedia computers.

#### Alcatel Subsidiary Mietic To Produce Submicronic ASIC's

91WS0422D Paris INDUSTRIES ET TECHNIQUES  
in French 14 Jun 91 p 16

[Text] Mietic, an Alcatel subsidiary specializing in mixed analog-digital ASIC's [application-specific integrated circuit] is preparing to move into submicronics. It has just begun construction in Oudenaarde, Belgium of a new plant capable of producing chips with etched patterns of 0.8 to 0.5  $\mu\text{m}$ , compared to 1.2  $\mu\text{m}$  today. This investment of nearly 600 million French francs [Fr], on sales of Fr470 million in 1990, gives it the means to supply the ASIC's market between now and the year 2000.

In just five years of existence, the 400-person company created by Bell Telephone and the Flemish government has become the European leader in ASIC's and the world's second-largest producer of mixed analog-digital circuits, which are used notably in telecommunications and the automobile industry. Alcatel bought the firm, using it as a strategic supply source for its telecom equipment. Mietec sells 70 percent of its production to Alcatel.

The plant under construction will include 3,000 square meters of class 1 clean rooms, split into two modules. The first will be finished in 1992. It will start by producing circuits with a critical geometry of 0.8  $\mu\text{m}$ . The second module will be completed before 1995. It will be used to manufacture ASIC's with patterns of 0.7 to 0.5  $\mu\text{m}$ .

For the first phase of the project, Mietec will be the beneficiary of a technology transfer from SGS-Thomson. For the next step, however, it plans to use the results of the Access research program, which is being conducted as part of the JESSI [Joint European Submicron Silicon Initiative] program, with the Grenoble CNET (National Telecommunications Studies Center) as chief contractor.

#### **France: Alcatel Produces Its Own Semiconductors**

91WS0474A Paris *L'USINE NOUVELLE* in French  
6 Jun 91 p 51

[Article by Jean-Pierre Jolivet: "Semiconductors: Alcatel Guarantees Its Independence"; first paragraph is *L'USINE NOUVELLE* introduction]

[Text] The French group no longer wants to depend on the big chip vendors. Its Mietec subsidiary will even be strengthening its position in the ASIC [application-specific integrated circuit] market.

Alcatel NV has dispelled a cloud over its future as the world's number 1 telecommunications company. The group has decided to build a new plant manufacturing submicron integrated circuits at the Belgian Oudenaarde site, thereby doubling the production of its Mietec subsidiary. By doing so, it strengthens its technological independence in semiconductors.

Independence in semiconductors has long been a subject of concern for Alcatel NV's chief executive officer, Pierre Suard. The major players in the field—AT&T, Siemens, Japan's Fujitsu and NEC [Nippon Electric Company] have always made semiconductors a part of their telecommunications strategy, even at great expense. Some observers see a formidable danger of dependency and even go so far as to paint a catastrophic scenario in which the major semiconductor vendors are bought up by Alcatel NV's competitors. Alcatel NV shoots back that "the standard components—microprocessors and other memory chips—are less strategic in telecommunications than in other areas like computers or consumer electronics." Still, SGS-Thomson's current flirt with Siemens has it worried. The

Franco-Italian chip maker is one of Alcatel NV's principal suppliers. Strengthening its technological independence has suddenly become a priority.

The choice of concentrating its efforts on ASIC's (specialized circuit's built to client specifications) was not random. "ASIC's represent half of the semiconductors used in telecommunications equipment. This share is going to be even greater in digital radiotelephony and the hardware," Alcatel Vice President Jo Cornu, who is also in charge of the group's technology, recently explained.

This analysis pushed the French group to act quickly. The initial investment of 570 million francs [Fr] in the new Oudenaarde plant should make it possible to keep up with the ASIC requirements of all the group's branches by 1993. Over 70 percent of Mietec's annual production of 160,000 semiconductor wafers is already used in the group's telephone exchanges, PABX [Private Automatic Branch Exchange] systems, and radiotelephony terminals and equipment. By 1993, the Oudenaarde unit will be producing 60,000 more silicon wafers a year and will have increased its total output to 150,000 wafers. Mietec is also using this investment to move into the submicron technologies (0.8-0.5 micron geometries, compared to today's 1.5 microns).

Mietec managers also want to play the card of a "Japanese-style" strategy in the ASIC niche, i.e., take advantage of their position within a powerful group to attack the commercial specialized circuit market. The size of the investment in the new plant shows that Alcatel NV leadership is listening—as well it might. The ASIC market is the current growth leader. "ASIC's are the market of tomorrow. Even microprocessors will move towards dedicated models," Mietec Product Manager Zenyk Horbowy predicted. The subsidiary hopes to use its doubled production capacity to increase its sales outside the group from 20 to 40 percent by attacking the robotics and automobile electronics markets. With gross revenues of Fr470 million in 1990 and 400 employees, Mietec is already one of Europe's major ASIC firms, alongside VLSI [Very Large Scale Integration] Technology, LSI [Large Scale Integration] Logic, and AMS—only four years after entering this market.

In the medium term, this strategy may pay very well for Alcatel NV. However, its management will also need to strengthen its technological independence in the field of gallium arsenide, the silicon of tomorrow's telecommunications equipment.

#### **France's CNET Develops High-Speed Silicon Transistor**

91AN0493 Paris *ELECTRONIQUE INTERNATIONALE*  
*HEBDO* in French 20 Jun 91 p 19

[Article by Francoise Grosvalet: "Silicon Field-Effect Transistors Catch Up With Bipolar Technologies"]

[Text] As a result of the innovative production techniques developed at the National Center for Telecommunications Research (CNET), the silicon field-effect transistors (FET's) are reaching the performance levels of top-of-the-range bipolar technologies.

Researchers of the CNET at Grenoble have succeeded in developing a new generation of silicon permeable-base transistors (PBT) with a typical maximum operational frequency of 26 GHz, which ranks them with the best bipolar silicon transistors. In addition, these PBT's are vertical field-effect transistors with all the advantages that this implies, including the capacity to supply high output currents and a relatively simple structure. According to Daniel Bois, who leads the CNET research team, these transistors seem to be likely candidates for the development of hyperfrequency devices in the 5-10 GHz wave band.

Permeable-base transistors are vertical FET's with an extremely short gate. This gate is made up of a metallic layer deposited at the bottom of trenches etched in the silicon. For this structure to obtain high switching speeds, trench widths have to be much smaller than 1 micron while the resistance of the metallic gate must remain low (thickness of about 0.1 micron).

#### Extend Frequency Range by Optimizing the Structure

The CNET researchers have succeeded in defining and etching 0.2- to 0.4-micron-wide trenches with a mushroom-shaped profile. To do this, they had to make use of several new techniques such as deep-ultraviolet lithography, vapor-phase epitaxy of silicon under reduced pressure, and oxide deposition aided by illumination. The mushroom-shaped profile is required, on the one hand, to passivate the slopes by deposition and selective etching of silicon oxide and, on the other hand, to evaporate a film of platinum and then gold while maintaining, thanks to the overhang of the trenches, good electric insulation between the source (top of the channel) and the gate (bottom of the channel).

The basic PBT prototypes developed at CNET provide significant transconductance levels (up to 125 microsiemens per millimeter) and a maximum transition frequency for a 26-GHz current gain. The maximum frequency for power gain is also 26 GHz. These laboratory results match the best laboratory results ever obtained with bipolar silicon transistors, it being understood that the best bipolar transistors being marketed today operate in the 10- to 15-GHz range. However, a comparison with bipolar technologies has to be made with prudence. Since the PBT is a vertical FET, it is not intended for the same applications. One should also remember that this was only an exploratory investigation and that no decision has been made with respect to the next steps to be taken in the project, even if the CNET researchers think that it should be possible to extend the frequency range by optimizing the architecture to reduce noise levels.

## NUCLEAR R&D

### Germany's Karlsruhe Center Develops Radiation-Resistant Ceramic

91MI0441 Bonn DIE WELT in German 20 Jul 91 p 20

[Article by Thomas Buhrke: "When Years Become Days in the Laboratory"]

[Text] The road taken by radioactive waste from the nuclear power plant or a major research institute to the place of final disposal is a long one, beset by many technical difficulties. One of these is the fixing of the radioactive substance in resistant materials such as concrete or glass.

But how stable are these materials under the effect of nuclear radiation or intrusion of water into the final storage site? A working group of the Karlsruhe Nuclear Research Center has developed a novel ceramic and has succeeded in testing its high resistance in a "time acceleration experiment." Radioactive wastes consist of a variety of isotopes; some of them decay very quickly, while others remain active for 10,000 years or longer.

Such long-lived isotopes are found in sludges, wastes produced when fuel rods containing plutonium are manufactured or reprocessed. At present, highly radioactive substances are bound primarily in glass. Of course, there are a few problems. For example, because of chemical incompatibilities, glass cannot contain more than around 15 to 25 percent by weight of waste. Moreover, if the concentration of nonsoluble precious metals exceeds a certain amount, they sink to the bottom of the glass melter and are deposited there. This is an unacceptable characteristic which presents the technicians with a number of problems.

Even when the substances are bound in cement, there are undesirable side effects. A high level of radioactive radiation releases hydrogen within the cement. This then slowly bubbles out and may cause the container drums to bulge.

A new ceramic appears not to pose these problems. It was developed at the Karlsruhe Nuclear Research Center and tested under the direction of Andreas Loida. In preparation for their final disposal, the radioactive wastes are first of all pretreated, then mixed with the ceramic substances kaolin, bentonite, and corundum; water is added and the mixture is shaped into cylindrical pellets.

Finally, the pellets are heated to 1,300° Celsius for around 20 minutes and compacted. This causes a variety of lattice phases to form inside, which envelope the radioactive substances, unlike in glass where the radio-nuclides are evenly distributed and incorporated into the crystal lattice. The new ceramic, called KAB 78, can take up to three times more radioactive waste than glass. This was found to be the case for all known waste mixtures. This means that less space is required for final disposal.

Moreover, long-term experiments have shown that the new ceramic appears to be more resistant than glass to brine such as would be expected if there were an intrusion of water in a salt dome.

Loida was able to use an ingenious time acceleration experiment to demonstrate that KAB 78 is also largely unaffected by the nuclear radiation of long-lived isotopes. Instead of binding normal long-lived waste into the ceramic and observing its durability over a period of about 10,000 years, he deliberately enclosed the isotope plutonium 238. This has a much shorter half-life and thus a far greater activity. It enabled the Karlsruhe minerologist to test the radiation exposure of the ceramic practically, using time acceleration. After eight and one-half months, the sample reached the exposure of normal light water reactor waste and after three years, that of waste from a fast breeder.

Loida and his Czech colleague Rene Pejsa checked the quality of the ceramic at certain intervals. No changes in the structure of the ceramic were found after the maximum exposure period, so this material is clearly extremely resistant to radioactive radiation. In fact, the ceramic was probably "overstressed" during the experiment, since generally speaking, materials are able to withstand long-term low doses better than short high doses.

Whether this development will be put into use in Germany is of course doubtful, since its advantages appear only with highly radioactive substances such as are produced during reprocessing. But the federal government is known not to want this technology used in Germany.

Neighboring countries, however, have already expressed an interest: the French in connection with the solidification of radioactive combustion ash, and the first contracts for the exchange of know-how have already been signed with the British. Last but not least, because of its generally good chemical compatibility with impurities, this new ceramic is also in principle suitable for binding nonradioactive highly toxic substances.

## TELECOMMUNICATIONS

### European Telecommunications Operators Create EURESCOM Research Center

91AN0501 Amsterdam *COMPUTABLE* in Dutch  
5 Jul 91 p 2

[Article by Yvonne Ton: "European Operators Join in EURESCOM"]

[Text] Twenty-two public telecommunications network operators from 16 European countries—including the Dutch PTT [Post, Telegraph, Telephone] Telecom—joined in the European Institute for Research and Strategic Studies in Telecommunications (EURESCOM).

The organization was set up last March, but cooperation was officially ratified last week in Heidelberg.

The joint initiative's main purpose is to coordinate the research activities of the individual participating concessionaires more effectively. In addition, this cooperation in the area of research should enable Europe to improve its competitive position with respect to the United States and Japan. "We shall have to determine in which areas we can complement each other," declared Prof. Eng. M. Antal, who works with PTT Research and who is a member of EURESCOM's Board of Commissioners. At this moment, Antal thinks there is a lot of overlap in the research activities conducted by the research centers of the 22 telecommunications operators. "Eventually, the creation of EURESCOM could lead to a higher integration of research activities."

The European research institute will mainly focus on such subjects as intelligent networks, broadband integrated services digital networks (ISDN), network management, and the Metran project (involving the development of very-high-speed "electronic highways"). Each of these subject categories encompasses one or several projects for which affiliated operators can sign up individually or collectively. A scientific body which remains to be created will advise on project assignments. In September and October, the first 11 projects will be launched. Depending on the objectives, new projects will be started within the framework of EURESCOM every year. However, during the first two years, absolute priority will be given to infrastructure works.

EURESCOM's headquarters are located in Heidelberg, a town which Antal says was probably selected because of its central location and because of the presence of numerous research centers in the neighboring area. Lisbon and Barcelona were the other possible host cities for the EURESCOM headquarters. The Swede K. Katzeff was appointed EURESCOM director; the rest of the 12 to 15 permanent staff members must be appointed as soon as possible. Last week, EURESCOM's budget for the remaining period of the present year was fixed at 15 million European currency units [ECU]. The precise budget for 1992, which is the first complete calendar year, is not known yet. The participants contribute according to their size, which is determined by the number of telephone connections. Antal cannot figure out exactly how much the Dutch PTT will have to contribute. "Obviously, PTT is only a small operator."

### EC: Standardization Process Behind Schedule

91AN0505 Amsterdam *COMPUTERWORLD* in Dutch  
26 Jun 91 p 51

[Article by Paul Ruell: "Lack of Time Forces European Telecommunications Standards Institute To Establish Priorities; Not All Standards Ready for European Unification"]

[Text] Not all standards will be ready when the Single European Market goes into effect. Frede Ask, the Danish



deputy director of the European Telecommunications Standards Institute (ETSI), admits that not all EC mandates will be completed in time: "It is clear that the major programs and mandates will be completed in time, but it is equally true that some less important standards have been put on a waiting list."

According to Frede Ask, this delay is a direct consequence of the lack of personnel and resources that his organization has had to cope with for quite some time now: "Expertise in telecommunications is scarce. ETSI has 12 technical committees and when the number of man-months required exceeds the available manpower, all we can do is establish priorities and make compromises."

ETSI will soon hold its annual technical assembly. The main items on the agenda are: user contributions, intellectual property rights (IPR), and standards for high-definition television (HDTV) and satellite broadcasts. An inquiry into the composition of ETSI's membership revealed that the percentage of users is decreasing every year: While users still represented 11 percent of the total in 1989, this percentage dropped to 9 percent last year.

This lack of enthusiasm is due to the high membership fees and the high traveling expenses involved in attending ETSI's technical meetings in Nice. At the latest meeting, a committee was set up which was to deal exclusively with this problem. The committee wrote a report and developed a 15-point plan which proposes, among other things, to reimburse the users' traveling expenses.

Assistant Manager Frede Ask thinks, however, that for financial reasons this proposal is not realistic: "We are fully aware of the importance of user involvement in ETSI's activities and we are willing to take action to encourage their participation. One action would be a substantial lowering of the membership fees for users. But our financial situation does not allow us to reimburse user traveling expenses. If the European Commission provides a budget for this purpose, we can look into the traveling expenses of the users attending our technical meetings. That is really all we can do."

The main item on the agenda is probably the delicate question of IPR. In addition to the trademarks, these intellectual property rights also cover all patents and copyright stipulations.

ETSI is operating a scheme enabling it to trace patented technologies at an early stage, because patented technologies have inevitably to be covered by new standards. "When developing new standards, one must choose from existing technical solutions. So it is possible that one of our members has a patent on one of those partial solutions; in that case, he must decide for himself what can or cannot be done. If he accepts that his technology is incorporated in the new standard, he must grant a 'fair, reasonable, and nondiscriminating license.' By proceeding this way, subsequent problems can be avoided,

hence the importance of having this matter discussed and clearly settled in advance," says Ask.

The new directives will also deal with patent problems which might occur after the public investigation, since ETSI wants to prevent any previously unknown item on the agenda at the very moment when Motorola claims the property rights for part of the technology used in the proposed new standard for digital cellular telephony? By definition, the problem of IPR is an international one and ETSI is known patent holder from instituting legal proceedings against companies which develop products based on the new standard.

Ask denies that ETSI's sudden interest in IPR was provoked by an existing problem; but could it be a coincidence that IPR has been hoping to cooperate smoothly with its American, Japanese, and Korean counterparts. ETSI would rather not burn its fingers to the politically very tricky problem of the future standards for satellite broadcasts and HDTV.

According to work program manager Yves Chauvel, these standards are, in the first place, the responsibility of the European Broadcasting Union (EBU), and only to a lesser extent that of ETSI: "Of course, ETSI is authorized to issue standards, whereas the EBU can only make recommendations, but in our view both HDTV and satellite broadcasts still fall within the EBU's sphere of competence.

"The stakes are very high and passions become overheated. So we think it is much too early to discuss these two standards on a public forum such as ETSI. The members of the EBU should first come to terms with each other. In order to be able to develop a standard, a consensus must first be reached, but so far a consensus is still up in the air. So let us wait until the EBU has sorted out the problem."

#### Siemens Develops New Push-Pull Receiver

91P60262 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 22 Aug 91 p 8

[Text] As part of the European research program RACE (Research in Advanced Communications in Europe), Siemens AG of Munich/Berlin developed a wideband low-noise push-pull receiver for optical telecommunications engineering. Initial results with a demonstrator system jointly manufactured by Siemens, Plessey and Philips in Caswell (UK) as part of the RACE program showed that, from a single transmitting center, more than a thousand subscribers can be provided with wideband services, such as television via fiber optic systems. One might even say that the theoretically expected increase in transmitting capacity could be achieved even in practice.

In the laboratory, using this receiver module, a sensitivity of -59 decibels, referred to 1 milliwatt (dBm), was



achieved for a 140 Mbit per second (Mbit/sec) heterodyne system employing frequency shift keying (FSK). This is believed to be a world's best performance, lying only 2.4 dB over the theoretical limit. Apart from being simple tunable laser diodes as a local oscillator, optical push-pull receivers are key components for heterodyne reception. Moreover, it is believed that they essentially determine the performance of that type of optical heterodyne systems. Heterodyne reception, introduced into radio engineering in the '30's and even now being tried out in optical telecommunications engineering, permits the use of more sensitive modulation techniques. The multichannel operation with small channel separation made possible thereby increases the transmission capacity of fiber optic cable by more than a thousand-fold.

According to Siemens, the heart of the receiver developed in its research laboratories in Munich-Perlach is a chip connecting two monolithically integrated photodiodes in series. The optical input signal, with the local oscillator signal superimposed upon it by means of a directional coupler, is converted into an intermediate electrical frequency by these photodiodes.

A three-phase high impedance concept was selected for the other stages of the push-pull receiver. In the first phase, the photodiodes' electrical signal is subjected to low-noise preamplification. The second phase provides an equalizer circuit for flat frequency response. The third phase was optimized via the best possible output matching at 50 ohms. As Siemens goes on to say, the low residual noise, amounting to a noise figure of 0.36 dB for commercial HF amplifiers, could be achieved without ripple effects in the frequency response.

#### **Siemens' HICOM 200 Telephone System Described**

*91WS0465A Heidelberg NET—NACHRICHTEN ELEKTRONIK & TELEMATIK in German Jun 91 pp 261-264*

[Article by Wolfgang Niedermeier, special adviser for private communications systems at Siemens: "Mobile Employees With up-to-the-Minute Information"]

[Text] The Hicom 200 from Siemens is a basic communications system for added-feature calling with user solutions for modern teams and offices. It can work together with fax, videotext and telex services and link computers with one another. The advantages of the modern ISDN [integrated services digital network] network can be conveniently and economically used. Up to 384 ports can be generously allocated to end equipment or switchboard lines.

But the communications system is technically capable of "starting out quite small." Because Hicom 200 can be expanded through modules. Telephones and end equipment for voice, videotext, fax and videotext services as well as standard telephones can be connected with it. But

full utilization is only attained with added-feature telephones. It is now possible to use this communications system even more efficiently.

#### **Modular Construction**

Hicom 200 is a new user solution with which telephonic availability is realized in a special manner. The "voiceless" times on the telephone are now over. It is possible to say with graphic simplicity that Hicom 200 is a personal voice mailbox, similar to what we know from the answering machine—only much more capable. Not only can Info 200 accept voice information and store it, it can also pass it on and distribute it to a designated area as data to be commented on, for example. Thus, it is simultaneously a mailbox and an attached post office.

Part of the systems concept are basic packages, basic user packages and three additional packages. Info 200 will be connected with the Hicom 200 communications systems and is already fully functional in its basic configuration through the Voice Manager basic user package. Expansion is possible in sensible upgrade steps. Technical changes in telephones or other telecommunications installations are not required.

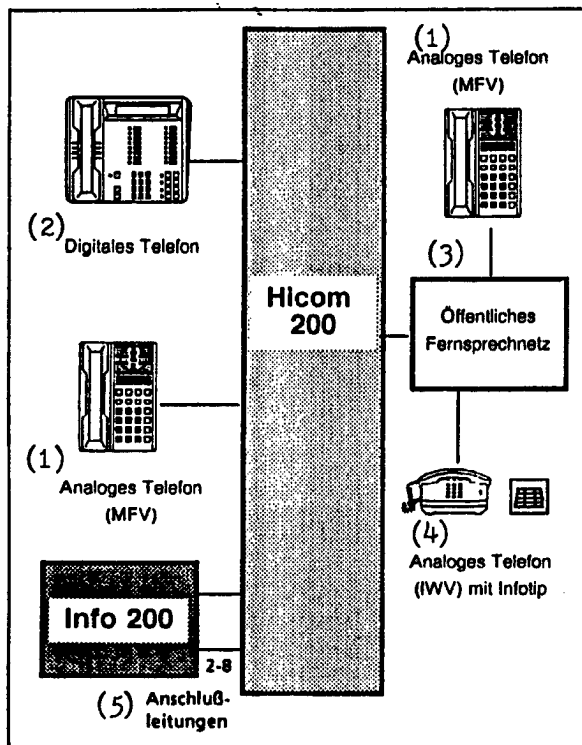
The Basic Package contains the hardware necessary for operating Hicom 200. The connection with the Hicom 200 communications facility takes place over a maximum of eight connection lines. A corresponding number of participant connections (a/b interfaces with multifrequency signalling [DTMF]) are designated for the telephone unit. The voice memory capacity generally amounts to six hours, regardless of the number of installed mailboxes.

A maximum of 500 mailboxes can be installed. A mailbox serves to store news or announcements. Mailboxes which are used to store news can also contain a personal message. The sum of the mailboxes (for example company announcement, information boxes) and the memory boxes (for example per participant) determines the number of mailboxes to be installed.

A modem (1200 bit/s) is integrated. Access takes place via the telephone installation. Changes in configuration are therefore possible by telephone service. In the event of a problem, the system automatically selects a preprogrammed telephone number. A protocol printer can be attached to the V24 interface.

The Basic User Package contains the software necessary for operation and offers basic performance. It is included in the equipment supplied with Info 200 and provides the following essential functions:

- Answering machine function with remote inquiry for everyone;
- Audio operating guide: the telephone tells you what to do;
- Information sent to a participant: A mailbox owner can send a spoken message to the mailbox of another participant—from anywhere and at any time;



**Info 200 is connected to the main facility by two to eight access lines. (Graphics: Siemens)**

**Key:** 1. Telephone (DTMF)—2. Digital telephone—3. Public telephone net—4. Analog telephone (EDS dialling) with Infotip—5. 2—8 access lines

- Information can be received from all over the world, at any telephone;
- Notification of the information received in the mailbox, optically or acoustically;
- Exchange function, meaning additional dialling when the line is free or busy. If the desired participant is not reachable, the caller can leave a message and/or dial another participant (DTMF telephone or Infotip necessary).

With touchtone dialling, the control functions (such as the code number) can be entered directly from the keyboard. Telephones with pulse dialling such as rotary dial telephones and private lines need the Infotip EDS transmitter in order to enter the data.

Beyond the Basic User Package, one may select from three additional user packages for special applications.

#### **Added-Feature Information Transmission**

User Package 1 Komfort offers added-feature processing and transmission of information.

The situation is a familiar one: You have to go on a business trip—and would still like to be plugged into the

company information flow. Your colleagues have no time to keep telephoning after you. And you would like to avoid the usual business of finding memo slips on your desk when you return. Here the solution is called Info 200.

Whenever and as often as you like, before or during the trip, you give Hicom Info 200 the number at which you can be reached and would like to receive confirmation about your own message. That can be any internal or external connection, a car telephone, the private or hotel number, including the telephone number of business partners with whom you are dealing at the time. Info 200 calls the predetermined telephone number, for which the period of time for the notification can be individually determined. If the connection is made, the owner of the mailbox gives his code number and can then receive the message.

User Package 1 includes the following important functions:

- Information service to any internal or external number;
- After listening to a message, the person can be connected with one or more mailbox owners with or without comments;
- Automatic reception confirmation for the message sent (registered with return receipt);
- Automatic distribution of messages to a certain circle of recipients;
- When the transmission is overloaded by too many calls, the callers are switched to Info 200 and receive a message.

#### **Information Service**

With User Package 2 Information Service, it is possible to receive specific current information at any time and everywhere.

The latest news or new decisions reach their recipients quite rapidly with Hicom 200. No matter how many, wherever they are—the information will only have to be spoken centrally once in information boxes. Any employee can dial these boxes at any time and—after giving an access authorization—make specific inquiries: in the first box, for example, the most recent prices and conditions, in the second current market data, in the next one the state of the inventory and in yet another the next pending sales action. More extensively, up-to-the-minute and, above all, faster than that, it is not possible to give out information.

User Package 2 provides:

- Information service—individual information boxes can be reached by dialling direct from any telephone (EDS or DTMF);
- Information system with multilevel menu selection, meaning by selecting one-digit numbers the caller can obtain the desired information or reach the desired participants.

With User Package 3 Ordering Service you get an automatic order-taking receiver around the clock.

Anyone who urgently needs painting materials does not want to wait very long for delivery. For that reason the order must be promptly and reliably received. Unreachable or unmanned ordering numbers mean a great deal more than annoying losses in income: all too often they turn into business for the competition.

With Hicom 200 it is possible to install a tailor-made, efficient ordering service. It can greet customers and is available to take orders day and night. Of particular importance is that with a structured menu selection—that is to say by dialling a number—the customer can direct his wishes correctly right away. For example, when placing an order for painting material there is wall paint under number 1, varnish under 2 and wallpaper under number 3. Since all important order data can be automatically requested, such as the delivery address, a smooth procedure is guaranteed. The answers to the individual questions are compiled and passed on to the responsible manager for further processing in his mailbox. The caller can hear his order once more to be sure, or if need be erase it and make a new recording.

User Package 3 is available as ordering service with an without dialog:

- automated order taking around the clock with question and answer boxes;
- Menu-structured information selection: By selecting numbers, the customer receives the desired information;
- With extension hunting, the overflow goes to an audio response box or is placed in a queue (without dialog). If the customer calls a very busy department and all the extensions are busy there, he is switched over to Info 200. He receives a message and is placed in a queue. Alternatively, he can be switched to a mailbox and leave a message there.

With the Hicom Info 200 communications solution the company and its employees are always reachable, and no call is ever lost any more. The information follows the caller wherever he wants.

#### **Alcatel Presents Current Projects**

*91WS0414A Chichester INTERNATIONAL  
TELECOMMUNICATIONS INTELLIGENCE  
in English 10 Jun 91 pp 4-5*

[Text] Last week, Alcatel presented journalists with the opportunity to see its vision of the network of the not-too-distant future. Indeed, it transpires that if standards-making bodies and politically-motivated companies could sort out their differences, this network might be with us a lot quicker.

Alcatel was announcing the introduction of its Alcatel 1000 range of public/private/hybrid products, based on Synchronous Digital Hierarchy (SDH) principles.

The range comprises a broadband switching module which will eventually integrate the company's two major public switch offerings, the E10 and System 12, SDH Add-Drop multiplexers, SDH cross-connects and SDH user terminals/ access devices and mobile communications systems.

All elements can be controlled by a single network management system which will also be able to control network elements sourced from other manufacturers.

The convergence of the System 12 and E10 digital public switches—with a combined worldwide market of 46.7 million terminations delivered at the end of 1990—will take place in two stages.

According to Alcatel, since the company's formation in 1987, it has been working towards the convergence of the two switches while allowing for the need for implementing Intelligent Network, network management and digital cellular applications on both switches.

The first phase of convergence—the introduction of the same applications on both switches—is now complete, with second phase just beginning with the addition of the same broadband switching module to each narrowband switch—the Alcatel 1000 E10 and Alcatel 1000 S12. This completed, the final merger of the two switches, the existing capabilities of each switch will be integrated in the broadband switch resulting in the Alcatel 1000 ATM switch—standalone—with complete broadband service capability.

Jozef Cornu, Executive Vice President, Business Development and Technical Operations at Alcatel NV, said, however, that although Alcatel already has the technology required to complete the development of the switch, its introduction and the introduction of the other products in the range will be governed by “the evolution of standards and of service definition”.

Citing US behaviour over the development of standards for the implementation of digital cellular networks, M. Cornu indicated with a wry smile that he thought definition of the relevant standards would be delayed until the Americans have what they want. The first delays will be introduced, he said, “by the dominant US switch manufacturers” in the definition of Intelligent Network standards.

Initially—that is by the end of this year—Alcatel will introduce the broadband module to perform as an extension of the narrowband switches and as a standalone switch. First glimpses—apart from those seen by journalists in Paris last week—will be at the Telecom '91 exhibition in Geneva in October.

In the 91-92 timeframe, Alcatel will also introduce its complete family of SDH/SONET products—line equipment, ADMs and cross-connects in the 50Mbit/s to

2.4Gbit/s range. The company will also begin to market its Alcatel 1190 MAN switching system after further development of the QPSX product to which Alcatel (and Siemens) has a licence.

The company already has commitments to introduce future broadband capabilities to existing narrowband installations:

In Australia, Alcatel has commitments to provide all narrowband Alcatel 1000 S12 installations with future broadband extension capability by 1991/1992;

In Belgium, Alcatel is committed to providing Alcatel 1000 S12 switches for both the ISDN and broadband parts with prototypes delivered in 1992 and pilot networks by 1994. Alcatel Bell Telephone Manufacturing is partnering a number of Belgian companies in the Belgian Broadband Association;

In France, the company will provide Alcatel 1010 ATM cross-connect systems for the BREHAT network in Brittany. Prototype units are to be delivered in 1992 with pilot networks constructed by 1993 and commercial operation by 1994;

In Singapore, Alcatel is committed to supply Alcatel 1000 S12 by 1993 and in Spain, Alcatel will supply an ATM trial network including an Alcatel 1000 switch by the end of this year.

Alcatel SEL has, of course, been testing its System 12, adapted for broadband switching, in the BERKOM network for the DBT since the end of 1989 and has commitments from the Deutsche Bundespost Telekom.

Commitments also exist to PTOs in Italy, Switzerland, Austria, the US and the Netherlands, although M. Cornu was not specific on which elements of the whole series were covered by these agreements. The commitments to SIP and PTT Telecom Nederland are for the Alcatel 900

Digital Cellular Mobile Radio System, while the commitment to Austria is for a MAN. Alcatel also recently received an order from PTT Telecom Nederland for a MAN system and says it is discussing MANs with BT.

Alcatel envisages a three layer SDH network structure—backbone and regional networks operating at between 600Mbit/s and 2.4Gbit/s and local networks operating at between 150Mbit/s and 600Mbit/s. User access will be at the lower of these two.

#### **Germany Plans Intelligent Network Trial**

*91WS0467G Bath ISDN NEWSLETTER in English  
17 Jun 91 p 1*

[Article: "Three In Telekom Intelligent Network Trial"]

[Text] Germany's national carrier, Telekom, has awarded Northern Telecom, Siemens and German Alcatel subsidiary, SEL, contracts for a 75 million German marks [DM] intelligent network trial. Each company is in partnership with a leading computer equipment maker and the trial is scheduled to begin in Spring 1993 in eight major German cities.

Northern Telecom is to supply a DMS-100 SuperNode switch for two German cities, Dusseldorf and Frankfurt on the Main. Its partner will be CBIS (Cincinnati Bell Information Systems). Siemens Public Switching and its partner, Siemens-Nixdorf Informationssysteme are to supply trial intelligence in Hamburg, Berlin and Hanover. SEL and Digital Equipment are to supply equipment and software for the trial in Stuttgart, SEL's home city, Munich and Nuremberg.

The IN will offer Telekom customers flexible new telecommunications services that can be tailored to meet their particular requirements. Telekom plans to deliver freephone/tollfree calling, televoting and opinion polling, voice messaging and single number facilities for distributed sites.

## DEFENSE R&D

### 91WS0482A Czech Passive Sensor Counter-Stealth System Described

Prague TYDENIK KVETY in Czech 25 Jul 91 pp 26-27

[Article by Martin Zajicek: "Can Tamara See The Unseeable"]

[Text] In recent weeks the press has carried reports that caused the hearts of more than one Czech to beat with pride—our experts had succeeded in developing a unique system that could identify the "invisible" airplane, the F 117 Stealth. Finally, we have again showed the world that we are no outsiders...was the meaning between the lines in several laudatory articles. Official military circles, however, counseled more reserve. Minister Dobrovsky pronounced the information about a miraculous super system to be "somewhat exaggerated." Nevertheless, Tamara continued to provoke numerous mutually conflicting conjectures. And as is the rule in our neck of the woods, euphoria was followed by skepticism. Maybe Tamara is just another journalistic canard. Do we have anything at all to be proud of? What is the truth anyway, and is there any way to find it out?

#### What We Know (And Don't Know) About Tamara

We will try here to present everything that has so far been made public, and what can be considered confirmed facts. Tamara represents the state of the art in high frequency technology. It is in fact an antenna with a large number of high performance amplifiers. It is capable of detecting the electromagnetic waves that arise around every conductor, such as for example during the operation of onboard instruments and navigational equipment in aircraft. The assistant production manager at Pardubice Tesla, where Tamara has been in production for several years now, asserts that the system can detect an aircraft that is as much as 400 kilometers from the installation. Tamara fits on eight Tatra trucks. Its price is around \$10 million.

This is all we know for sure. All the other information is either pure speculation or wishful thinking. Besides the project engineers and a small group of others no one knows precisely how large the impulses are that Tamara can detect, at what distance, and with what degree of precision it can measure and identify an aircraft. From the mere detection of waves to practical use is just as long a path as the one from nuclear fission to the construction of the first nuclear power plants. In other words, if we want to maintain with a clear conscience that Tamara can "see the unseeable" we would have to have available much more scientific data than has so far been made public. And since Tamara will probably remain for some time a top secret piece of equipment, to which there can of course be no objection, both the army and the manufacturer will be stingy with their information. I have learned this first hand. When I went looking for more details I ran right up against a barrier of silence.

"We had to tighten the screws," was the way that the director of Pardubice Tesla expressed his "no comment," after his secretary had already made several denials over the phone. "I am not going to tell you any more. Enough has leaked out already to damage our business interests."

But this is the best advertising that Tesla could hope for, I countered.

"On the contrary, it is damaging. It is not good when Tamara is the subject of discussions in parliament, and even in the Metro. This is not, I would say, normal...."

#### What We Know (And Don't Know) About The Invisible

The supersecret project "the invisible bomber" was announced by the American army for its court contractors sometime in the mid-1970s. The competition was won by Lockheed, whose experts convinced the generals that an aircraft invisible to radar no longer had to be confined to science fiction novels. A development team at Lockheed began working on a project named Have Blue in 1978. They were successful much faster than even the optimists had hoped. Stealth remains among the most closely guarded "capabilities" of the U.S. Air Force. The maintenance of the secrecy itself has cost hundreds of thousands of dollars. The test planes took off only from secret bases buried in the Nevada desert, and always no earlier than 30 minutes after sundown. During the day they rested far underground in bunkers that could withstand nuclear blasts. Until 1989 no one really knew how the Stealth even looked. The army decided to present the plane to the public the year before last, and the wags maintained that they were forced to do so by a plastic model "The Invisible" which became a hit in the pre-Christmas market. Its manufacturer quickly announced that it had guessed the shape of the plane based purely on stories from people who had by chance come upon the Stealth when it was landing.... No one really believed them but the army had no alternative but to take the wraps off the plane.

The first curiosity seekers who saw the Stealth agreed unanimously that it reminded them most of all of the "vampire" machine in Batman comic books. The triangular form, the black surface.... In any case Stealth looked nothing like anything that had ever flown before. The engineers achieved their hoped for "invisibility" thanks to the shape of the plane and a special fuselage coating. The purpose of the shape was to reduce to a minimum the surface that could reflect a radar beam, while the special coating absorbs the heat from the engines that attract heat seeking missiles. Stealth is therefore not only practically invisible to radar, it cannot, practically, be shot down. The word "practically" defines the range for conjecture.... The incontrovertible fact is that whenever Stealth has been put in the line of fire, in Panama and in Iraq, all the planes returned to their base without problems (the Americans currently have more than 60 of them, by the way).

The first person to announce the end of this invisibility was the head of armaments and technology for the Czechoslovak army, general Oldrich Barak. He is a general in an army whose equipment brings only thin smiles to the faces of those to the West of us. These are real paradoxes, is probably what the brewer would say in the play Audience, written by our president. These are....

...the more so because the Americans themselves consider this "invisible bomber" to be their most effective offensive weapon. Operation Desert Storm was begun by hundreds of Tomahawk cruise missiles, but right after them F 117 Stealth aircraft from the 37th tactical wing of the U.S.A.F. penetrated enemy defenses. Their objective was to destroy 26 of the most important and also best defended command centers...they finished the job in a couple of hours. The bombs dropped by the planes that came over the target before the Iraqis even detected them, penetrated the reinforced concrete bunkers with fascinating precision, as could be seen by television viewers, even down ventilation shafts.

The end of this proverbial invisibility was the work of scientists in a small country. Most Americans don't even know if we are located in Europe or in Asia. These are paradoxes.... Are they?

#### Tamara vs Stealth

What would be the outcome? It is difficult to say. It is probably a puzzle for those who designed Tamara. On the contrary, the Americans know 99 percent of it. We sold one installation, you see, to the former East German army, from where it fell into the hands of the Bundeswehr. Tamara is no longer a mystery for NATO experts, while the "invisible" Stealth remains a mystery to us.

Tamara is sometimes erroneously compared to the American AWACS warning system located on board Boeing aircraft. They probably have in common only the military jargon of their names, as so-called early warning systems, but there the similarity ends. AWACS is basically a perfected, "flying," radar while Tamara sits firmly on the ground with only a sensitive antenna pointed skyward. This is also the source of the most frequent doubts as to whether Tamara would actually catch a Stealth. The possibility exists after all that the "invisible" can fly for a period of time blind, with instruments switched off, so that it would give off no signals. Tamara would not be able to handle this, clearly. And there is one more variable here. Recently reports have appeared in professional journals that....

#### The Americans Had Found a UFO

For months now there have been many reported sightings of strange flying bodies taking off from secret Nevada bases. The journal Aviation Week and Space Technology evaluated 45 reported visual sightings and to this extent at least penetrated the closely guarded U.S.A.F. kitchen. The descriptions agree on three kinds of planes (or flying bodies):

1. A flat, triangular shaped plane with rounded edges. It moves through the air with little sound and very fast.
2. A body roughly 300 meters long, with an indefinite shape. It issues an extremely loud, thundering sound. Experts call this the pulser.
3. A glowing plane that flies at an altitude of more than 17 kilometers and a speed of at least 5,000 kilometers per hour. Nighttime observers describe it as a "white, glowing point," that was 70 degrees above the horizon not 20 seconds after takeoff.

These are probably additional prototypes of the "vampirish" bombers. Some could be the result of the mysterious Aurora project, the goal of which is to develop an airplane without a crew that can fly as fast as 10,000 kilometers per hour. That Aurora is more than the fruit of diseased scientific minds is clear from the fact that after completing the successful "invisible" F 117, Lockheed did not lay off a single one of the engineers who worked on the project, meaning that it received new important orders from the army. Will Pardubice Tamara be able to handle them as well. Why not?

Just before this edition of TYDENIK KVETY went to press we learned another interesting thing. Tamara is apparently not the first weapon in history that allowed us to surpass American technology. The A.S. Popov Research Institute, it seems, developed a radar that was able to fix American B-52 bombers. After providing it to the Vietnamese army, the Americans started losing one plane after another. Who says that Czechs aren't old hands at this....

## ENERGY, ENVIRONMENT

### Acid Emissions To Be Adjusted to EC Levels by 1997

91AN0500 Rijswijk POLYTECHNISCH WEEKBLAD  
in Dutch 4 Jul 91 p 1

[Article: "Poland Wishes To Adapt Its Emission Standards to Western Level by 1997"]

[Text] The Polish Government wants to impose radical restrictions on the emission of acidic substances. As of 1997, Poland will put into effect emission standards that are commensurate with—and in some respects even stricter than—current regulations in Western Europe. This was declared by A. Pierzak of the Polish Ministry of Industry during his recent visit to the Netherlands.

As a result of the stricter standards, flue gas scrubbers will have to be built in many of the power stations. The power stations will also have to use more expensive types of coal with a lower sulfur content. Pierzak also said that his ministry wants to reduce the amount of coal-supplied power to about 50 percent of total energy requirements. At present, almost all of Polish industry operates on coal or brown coal. Part of the coal should be replaced with oil or gas.

Pierzak paid a visit to the Netherlands Energy Research Center (ECN), where 20 Polish energy managers have just completed a three-month training program. This course involved a few weeks of theoretical classes, followed by practical training sessions in power stations and in such organizations as the Dutch Quality Control Institute for Electrical Materials and Appliances (KEMA). The courses focused on modern coal technology, environmental impacts, and management structures in the energy sector. For the practical implementation of the theory, the Poles will have to rely primarily on their own initiative; since the energy sector was placed under the Ministry of Industry a few years ago, there is hardly any coordinated approach. The power stations are more or less free to determine their own policies.

#### **Energopomiar**

The Dutch training program is supposed to be continued in Poland. In autumn, a workshop on energy planning will be organized for energy experts from the Ministry of Industry. KEMA also has plans to cooperate with its Polish counterpart Energopomiar in the field of environmental technology and quality control. Within the scope of the construction of a flue gas desulfurization unit in the Belchatow power plant, KEMA will be entrusted with environmental measurements and quality control. In this power station an initial flue gas desulfurization unit will be built, with financial support from Dutch electricity producers. During the Belchatow works, KEMA is to train a number of Polish engineers, who will in due course carry out the environmental measurements themselves.

### **S&T POLICY**

#### **Minister Pungor: R&D Ideas, Not Money, Lacking**

*91CH0844X Budapest REFORM in Hungarian  
25 Jul 91 pp 6-7*

[Interview with Dr. Erno Pungor, minister without portfolio and chairman of the National Technical Development Committee (OMFB), by Attila Samu: "They Submitted Something and Dared To Call It a Proposal"; first paragraph is REFORM introduction]

[Text] Rumors are that the "little tigers" from Asia spent the highest amount of money on research and development when their economy was at its deepest point. Thereafter they got wherever they got, somewhere at the leading edge of the world. In Hungary, however, virtually all research institutions are crying like—God forbid!—tiny church mice, they don't have money, they don't have this or that. Is this really true? Dr. Erno Pungor, minister without portfolio and OMFB chairman, discussed this matter with REFORM.

**Pungor:** The claim that there is no money is greatly mistaken at least insofar as the research institutes are concerned, we were told by the internationally acclaimed

professor of analytical sciences. In accurate terms they could say that there was little money in Hungary for central and state R&D functions and at the same time they should also state that the utilization of even this small amount of money ran into obstacles because they did not have enough feasible ideas. And this is the real catastrophe. In the framework of the OMFB competitive system we reached a point where we cannot accept about 80 percent of the proposals submitted simply because they cannot be regarded as proposals.

**REFORM:** Just whom are you qualifying by claiming this almost 80 percent failure rate?

**Pungor:** Obviously those who submitted something and dared to call it a proposal. I will note here that those who proposed the "development" of things that may be obtained on the street or that are even worse than that also qualified themselves.

**REFORM:** Could you reveal the extent to which you are able to effectively represent the above-mentioned areas in Cabinet sessions?

**Pungor:** Insofar as I am concerned I would prefer to see an improvement in the efficacy of R&D first. At this point we find ourselves in a situation in which we can award 1.5 billion forints of the available 5 billion forints, if we are generous. And this is the problem, notably that every complaint may be translated into Hungarian by saying that we do not have enough feasible ideas.

**REFORM:** You know, it's interesting that at this time researchers come to you for money, while previously you were sought out by heads of governments. For example, Miklos Nemeth paid a visit to you at the Technical University, perhaps because he wanted to "sneak" you into the government.

**Pungor:** He did not want to sneak me in; he offered to me the position of industry minister. But I did not accept that offer even at the request of Prime Minister Antall because I was not competent in that field. In the end he asked me to chair the OMFB and I agreed to that.

**REFORM:** Forgive me, but you got what you deserved; your upstairs neighbor rang your bell—since you live in the same building as the prime minister.

**Pungor:** Look, this is nonsense. First of all he is not my upstairs neighbor but my downstairs neighbor. They had been looking for me earlier and I discussed the research field with a host of people. Moreover, despite the fact that the prime minister and I have been living in the same building for 21 years, we did not run into each other often, not even in the stairway. Very simply, our time schedule was different.

**REFORM:** On the other hand you were exempted from being accused of lacking professional competence, because even as an academician you were able to view the prevailing cabinet from the inside. Is this a cabinet of experts?

**Pungor:** A cabinet of experts cannot rely on parties, at the same time the present cabinet consists of members of the three parties and of a few party outsiders. Despite this, I respectfully submit that whoever claims that this cabinet has no expertise is a liar. This is an overall comment of a kind about which I do not want to go into detail.

**REFORM:** For quite some time the OMFB functioned without a chairman, and now a strong man was put in charge—it seems that way at least. Elsewhere we find an estimate: 15 percent of the Hungarian researchers who accepted jobs abroad have indicated that they had no intention of returning home. Could it be true that they are afraid of “the” Pungor?

**Pungor:** Come on now, just look at me! They are much rather concerned about not being able to make a living out of the salaries they receive at universities and institutes. Other than that, their Hungarian institutes are not appropriately equipped; they are attracted to foreign countries by the equipment and the appropriate value placed on research. I know of two kinds of brain drain. The one that can be reversed, i.e., when someone goes to do research at an institute with appropriate parameters, trains himself constantly, and returns once the conditions that have evolved in the meantime are established at home. And then there is the irreversible brain drain. This happens when a young researcher works under the supervision of a bad leader and a fear of competition evolves. This manifests itself in a situation in which the leader pushes under water the unfortunate talent until that talent drowns in the water. Unfortunately the latter process occurs more often in Hungary.

**REFORM:** The assessment of the performance of researchers is a hot topic nowadays in Hungary. What is your view of the equivalence reference index, of scientific grades? In general, what could serve as a yard stick?

**Pungor:** Exclusively the end result in terms of developmental work. Basic research is another matter, but even there one should not make a fetish out of the number of instances a researcher has been cited. And I believe that in principle the system of titles must by all means be related to functions and performance.

**REFORM:** And what is the situation in Hungarian practice?

**Pungor:** The two things cannot be related if in earlier days a person received his appointment on a buddy-buddy basis, so to speak. You better ask a wise woman from Buda whether many or only a few such appointments were made or bequeathed to us, because it would be meaningless to say something about a technical person without making a specific assessment.

**REFORM:** And yet, for example, you made statements earlier according to which “...some of our university professors are unsuited to conduct serious research or development...” Don’t you think that your fellow professors will be offended sooner or later?

**Pungor:** Proposals that make sense may be submitted by anyone, and everyone has a chance to receive resources, and thus the crisis may be dispelled. But how can a person be offended if he is unable to submit a sensible proposal? I am convinced that the financial crisis of those who complain is caused primarily by their intellectual crisis. And otherwise, it is life, not me, who qualifies these persons.

**REFORM:** These persons, who despite this fact continue to be university professors even today.

**Pungor:** It will be possible to resolve all this in the framework of a general higher education and research-reform program without downgrading academicians and university professors, without breaking lives in half. We must build parking lots in which these persons are able to be capable of working commensurate with their own level of competence.

**REFORM:** And are you already building these parking lots?

**Pungor:** Ask this question from the rest of the ministers....

### **Hungary: National Scientific Research Fund Restructured**

*91WS0508a Budapest COMPUTERWORLD/  
SZAMITASTECHNIKA in Hungarian 30 May 91 p 21*

[Article by Zsuzsa Szekeres: “OTKA Restructured”]

[Text] In January 1991 the government reorganized the committee distributing the National Scientific Research Fund (OTKA). It became an independent organization and three standing committees, each consisting of 22 to 24 scientists, were created within the framework of it. One is for natural sciences dealing with life, one for natural sciences not dealing with life, and one for the social sciences.

The first urgent task of the new organization was to review the requests submitted in 1990 to the previous research fund, for the money of the researchers has been used up, and they were counting on new sources.

On 31 January the committee decided to turn to support of the 1990 competitions; two thirds of the 1.8 billion forints made available by the state budget for 1991. In the course of a later competition, they will use 300 million forints for tools and for the information structure and to support young researchers; they will hold 270 million forints for 1991 competitions, and they will use 30 million forints for the costs of the scientific fund. Of the 1.2 billion forints for the 1990 competitions, 44 percent will go to nonlife sciences, 36 percent to life sciences, and 20 percent to the social sciences.

The new committee accepted 2,443 of the 3,283 bids, which is 74 percent. This decision supports more projects, but with reduced funds. Thus, small groups and young competitors can get more support.

In our table we publish the winners in the computer technology area and the sums awarded, as judged by the computer science, mathematics, operation research, informatics, telecommunications, automation, electronics, and electrotechnical juries. [Tabler not included]



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